

# Themes for future trans-national transport research programming

Results of a Delphi survey

Appendix to del. 2.2

January 2005

For further information on this report,  
please contact:

### Work package 2 leader

Ministry of Transport, Public Works and Water Management  
P.O. Box 20901  
2500 EX The Hague  
The Netherlands  
Phone + 31 70 351 7678  
Fax +31 70 351 7550  
www.verkeerenwaterstaat.nl

drs. A.F. van Ommen  
www.transport-era.net under Workplan and WP 2

### Main author

Transport Research Centre  
P.O. Box 1031  
3000 BA ROTTERDAM  
The Netherlands  
+ 31 10 2825993  
+ 31 10 2825642  
www.rws-avv.nl

drs. S. Halbesma  
www.transport-era.net under Workplan and WP2

For further information on the ERA-NET TRANSPORT programme,  
please contact:

### Coordination and Secretariat

TÜV Management Systems GmbH  
Am Grauen Stein  
D-51101 Köln  
Phone +49 221 65035 111  
Fax +49 221 65035 115  
www.tuvpt.de

Oliver Althoff (Coordinator)  
www.transport-era.net under Contact

### Secretariat

TetraPlan A/S  
Kronprinsessegade 46 E  
DK-1306 Kopenhagen  
Phone + 45 3373 7100  
Fax + 45 3373 7101  
www.tetraplan.dk

Anette Enemark  
www.transport-era.net under Contact

***This document was created as part of the  
ERA-NET TRANSPORT programme.  
All information is public and we encourage the use.***

***Copyright (c) 2005***

***Copyleft: Permission is granted to copy, distribute and/or  
use this document under the terms of the  
Free Documentation Dissemination License, Version 1,  
available at <http://pauillac.inria.fr/~lang/licence/v1/fddl.html>***

Version no.: FINAL 1  
Date of publishing: February 2005  
Written by: Sieds Halbesma, Henk van Zuylen  
and Marien Bakker, Ministry of Transport,  
Public Works and Water Management,  
Delft University of Technology,  
Connekt and SenterNovem  
All: The Netherlands

Deliverable no.: 2.2 (appendix)  
Project no.: ERAC-CT-2003-10223  
Project acronym: ERA-NET TRANSPORT  
Project title: ERA-NET TRANSPORT  
Instrument: Coordination Actions  
Thematic Priority: ERA-NET  
Project duration: 010104 – 311207

# List of content

## Summary

<b>1. Introduction .....</b>	<b>1</b>
<b>2. Research approach.....</b>	<b>3</b>
2.1. <i>Introduction .....</i>	3
2.2. <i>Delphi survey preparation .....</i>	4
2.3. <i>Delphi survey phase 1 .....</i>	5
2.4. <i>Delphi survey phase 2 .....</i>	5
2.5 <i>Delphi survey phase 3 .....</i>	6
2.5 <i>Delphi survey phase 3 .....</i>	6
<b>3. Research results .....</b>	<b>7</b>
3.1 <i>Introduction .....</i>	7
3.2 <i>The workshop .....</i>	7
3.3 <i>Policy domain Equity and Accessibility .....</i>	8
3.4 <i>Policy domain Economic development .....</i>	10
3.5 <i>Policy domain Safety and Security .....</i>	13
3.6 <i>Policy domain Efficiency .....</i>	15
3.7 <i>Policy domain User satisfaction .....</i>	17
3.8 <i>Policy domain Environment .....</i>	19
<b>4. Research conclusions .....</b>	<b>21</b>
4.1 <i>General conclusions .....</i>	21
4.2 <i>Differences between old and new member states .....</i>	21
4.3 <i>Integration of policy instruments and research themes and topics.....</i>	22
<b>Appendix 1</b>	
<b>Appendix 2</b>	
<b>Appendix 3</b>	



## Summary

A three-phase Delphi survey has been held in order to identify themes for trans-national research cooperation. A group experts has been asked to give their views on

- relevant trends,
- policy problems to be investigated, and
- policy instruments to be developed.

The survey was aimed at the following policy domains:

- economic development
- transport efficiency
- safety and security
- environmental aspects
- equity and accessibility
- user satisfaction

With policy instruments all kind of tools, methodologies and tactics are meant, to realize certain policy goals. The participants could propose policy instruments in the following classes:

- decision support tools
- financial tools
- information and awareness
- infrastructure provision
- integration of transport and infrastructure systems
- intelligent transport systems and services (ITS)
- regulation and deregulation
- land use planning
- transport and infrastructure management
- pricing and taxation
- vehicle technology

In total 28 experts from 16 European countries and 2 international organisations in the field of transport participated in the Delphi survey. In the first phase of the survey a questionnaire was sent to 50 experts from the countries participating in ERA-NET Transport, the other EU 2003 countries, the EU 2004 assessed countries and several international organisations. The response rate of the questionnaire in the first phase of the Delphi survey was 40% (20 responses out of 50). In the second phase these respondents were asked to react of the result of the first phase. This questionnaire was returned by 15 experts. In the third phase 7 experts were invited to participate in a workshop to verify and specify the results of the Delphi questionnaires.

The results of the workshop can be considered as the final result of the Delphi survey. Per policy domain the following was concluded:

- Equity and Accessibility

General trends in society seen as most important are the ageing population, social exclusion, the secondary effects of road pricing and the reduced urban accessibility. The challenges offered by these themes are partly taken into account by policy goals like the improvement of urban passenger transport and reliable urban accessibility. Knowledge development and decision support systems are recommended to facilitate the introduction of road pricing and to manage urban sprawl.

- Economic development

Changes are emerging in regulation and market development. Transport pricing is an example. The dependency on oil has important consequences. The change of the economy by a shift of production will also be important. Knowledge is needed about impact of the trends and to convince politicians about the need for measures. Further development of better and cheaper maintenance of transport infrastructure is an important direction of development.

- Safety and Security

Most important trends in society are improvement in safety and security in traffic and Internet. Perceived safety is still a problem, while different monitoring systems are introduced for automated surveillance and tracking and tracing. Still there are challenges such as the need to protect the most vulnerable users and to avoid negative consequences of technological innovations. Several instruments are seen as effective to realise the policy goals. Technological means in the car and in the environment, all kinds of ITS applications like advanced driver assistants and GPS.

- Efficiency

Efficiency of transport systems can be improved by standardisation of different components, e.g. rail, pricing. Furthermore, the use of spare capacity, e.g. of roads and reduction of empty trucks and the integration of modes are seen as promising directions for development.

- User satisfaction

The area of User Satisfaction is less structured as other policy areas. Many policy goals and instruments are also contained in other policy areas. This area has more the characteristic of giving emphasis to certain aspects of policy instruments, e.g. to include user quality in public transport contracts. Specific in this area is the demand for attention for tourism. Furthermore, there is a need for good information for the public about costs and benefit

- Environment

Air quality and noise pollution are very serious traffic related problems that deserve more attention. The limited approach, e.g. the limitation of noise emission to road traffic and the focus on CO<sub>2</sub> neglects important problems and opportunities for improvement. The technology seems to be available, but the introduction in practice requires more attention.

---

The representativeness of the Delphi survey can be considered as just sufficient for the purpose of the study. Additionally, the professional quality of the respondents was very high. Some indications are found that new members states have different priorities than the older states, e.g. they are more concerned about interoperability of rail, while the old members states are more concerned about fair and efficient pricing, the future of oil availability and regional cooperation.

---



## 1. Introduction

The objective of the ERA-NET TRANSPORT (ENT) programme is to provide instruments to transport and research policy-makers by offering information about future challenges and European research priorities in the field of transport. Furthermore, it aims in providing joint procedures, joint programming and joint project management guidelines.

The identification of potential themes for cooperation in trans-national research programming is divided into 2 specific tasks within the ENT programme. Cooperation in the short term is identified in Transport Research Road Map of the ENT programme. This Road Map was published in October 2004 and presents 6 Areas for cooperation, based on the analyses of the actual research programmes in the involved countries. In the second task the potential themes for future cooperation (in the long-term) need to be identified to develop the thematic framework for the newly to create trans-national research programmes.

This report deals with the identification of the themes for future cooperation in transport research programming. The results of ENT research regarding future research themes, based on a Delphi survey with transport research experts from all parts of Europe, will be presented. The next chapter describes the several phases in the research approach of the Delphi survey. Chapter 3 presents the results of the survey. The last chapter gives an overview of the conclusions. The results of the Delphi results will be discussed in a Research Policy Seminar in the spring of 2005 with representatives of the participating countries in ERA-NET TRANSPORT for their relevance in the programme. Based on the conclusions of in the Policy Seminar two themes will be selected to identify actual cooperation and coordinations activities in 2006 and 2007.



## 2. Research approach

### 2.1. Introduction

To identify the relevant and potential themes for future transport research programming to discuss in the Research Policy Seminar, ERA-NET TRANSPORT made use of the Delphi survey method.

For the determination of future research themes a Delphi survey is a validated method. The procedure is to ask experts about their opinion, priorities and preferences in several iterative steps. The output of a step is used to prepare the input of the next step. The Delphi method is especially suited to create consensus among experts about rather uncertain issues. In the preparation towards the Delphi survey interesting themes for future transport programming are identified by desk research. The next paragraph presents the preparation phase of the Delphi survey.

To bring focus to the research themes a three-phase process in the Delphi survey is being followed. In the first phase the number of themes is extended and focussed by asking about priority themes and new themes. Also the suitability of themes for trans-national cooperation is investigated. This first phase is presented in paragraph 2.3. In the second phase of the survey, described in paragraph 2.4, the themes that appear to be relevant for most researchers are further analysed in terms of the need for knowledge and the urgency. This phase and the preceding one are executed by means of questionnaires sent to approximately 50 experts in Europe. The third phase was a workshop with several experts, who are asked to evaluate the results of the questionnaires. The last paragraph of this chapter describes the phase 3.

A Delphi survey has the objective to gather the views of many experts and to get consensus about the priorities. In general a process aiming at consensus will not be the best way to find creative, new views. The strength of a process like Delphi is that the existing ideas are gathered and that a focus emerges. In many cases it appears most of the themes that come out of the survey are known for a great deal, but that the structure and priorities are new.

To structure the Delphi survey the research themes have been ordered according to the two dimensions Policy domains and policy tools.

#### ***Policy domain (category of goals and problems)***

- economic development
- transport efficiency
- safety and security
  
- environmental aspects
- equity and accessibility
- user<sup>1</sup> satisfaction

#### ***Policy instruments***

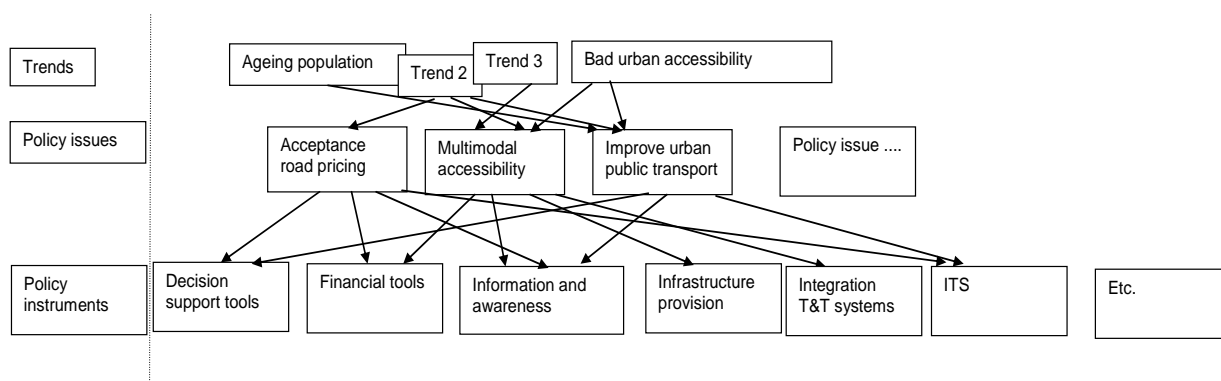
- decision support tools
- financial tools

---

<sup>1</sup> User is the transport user

- information and awareness
- infrastructure provision
- integration of transport and infrastructure systems
- intelligent transport systems and services (ITS)
- regulation and deregulation
- land use planning
- transport and infrastructure management
- pricing and taxation
- vehicle technology

The term *Policy instrument* has to be understood in a wide sense. It means all kinds of tools, methodologies and tactics to realize certain policy goals. Most policy instruments can be used for several policy goals, e.g. the tool *vehicle technology* can be applied for the improvement of the environment (clean engines), for the economy (less fuel consumption, alternative fuels), for safety etc. In the policy domain we can distinguish between several goals and problems to reach some policy goals. The priority for a certain goal and the related problems often emerge as a result of certain trends. We can represent this as follows:



## 2.2. Delphi survey preparation

The preparation of the Delphi survey focussed on the identification of societal and transport trends on the global, European and international scale and the identification of relevant experts to participate in the Delphi survey.

Based on the results of the ERA-NET TRANSPORT questionnaire that was sent to all national represents in the programme Committee of the Frameworks Programme (in the first half of 2004) the most relevant foresight surveys in the involved countries were identified and analysed. The analyses resulted in a basic list of trends and research themes addressed to the structuring dimension policy domains and policy instruments.

The identification of the relevant experts to involve in the survey was based on the following criteria:

- an equal division of experts in the field of the used policy domains and instruments
- 3 experts from each ENT country
- 2 experts from the other EU 2003 countries
- 1 expert from the EU 2004 accessed countries
- 1 expert of several international organisations
- In total 50 experts were selected.

### ***2.3. Delphi survey phase 1***

In the first questionnaire the results from the desk research was incorporated. The experts the following four questions were asked to the experts:

- Review and extend the given list of trends.
- Review and extend the given list of research themes and related policy instruments.
- Indicate the importance of the listed themes for your national transport policy at present and in the future (in 10-20 years).
- Indicate the possible need for, and advantage of, trans-national cooperation in research on the different themes.

In total 20 experts from 16 different countries and international organisations responded to the questionnaire with valuable information. Appendix 1 presents a table with the participants in phase 1.

The returned questionnaires have been analyzed and a prioritization of policy goals was established. The question for the next phase was to verify the prioritized list and select the most important policy instruments.

### ***2.4. Delphi survey phase 2***

The results of the questionnaire from phase one were analysed and incorporated into phase 2 of the survey. Trends were distinguished in important and less important, according to the priorities given in the first phase. Again a questionnaire was developed and sent to all (in the preparation identified) experts. The specific questions in this second questionnaire were:

- Review and add the given list of trends.
- Review, add and specify the given list of more important and less important research themes and related policy instruments.
- Indicate the importance of the listed trends for your national transport policy at present and in the future (in 10-20 years).

15 Experts in total from 10 different countries and international organisations delivered relevant information. The respondents of the phase 2 questionnaire are presented in Appendix 2.

### ***2.5 Delphi survey phase 3***

The last phase in the survey consisted of an expert meeting / workshop. The result of the previous phases were again analysed and used as the input for the experts meeting. 7 experts from 7 different countries in Europe attended the meeting. The participating experts are presented in appendix 3.

1. Review and add the given list of trends.
2. Review, add and specify the given list of more important and less important research themes and related policy instruments.
3. Indicate the importance of the listed trends for your national transport policy at present and in the future (in 10-20 years).

15 Experts in total from 10 different countries and international organisations delivered relevant information. The respondents of the phase 2 questionnaire are presented in Appendix 2.

### ***2.5 Delphi survey phase 3***

The last phase in the survey consisted of an expert meeting / workshop. The result of the previous phases were again analysed and used as the input for the experts meeting. 7 experts from 7 different countries in Europe attended the meeting. The participating experts are presented in appendix 3.

## 3. Research results

### 3.1 Introduction

This chapter presents the results of Delphi survey. Paragraph 3.2 describes the workshop and the questions that were asked to the participants. Paragraphs 3.3 until 3.8 describe the result of the workshop, the most important trends and research themes related to the policy domains Equity and Accessibility, Economic development, Safety and security, Efficiency, User satisfaction and Environment. In the last paragraph the general conclusions, overviewing the prioritised research themes in all domain, will be presented. These conclusions are the basis for the discussions in the seminar for identifying the ERA-NET TRANSPORT themes for future trans-national transport research programming.

### 3.2 The workshop

The workshop was intended to verify the outcomes of the two questionnaires, to use the expertise of the participants to complete and order the results and to give priorities to research themes. The workshop had the objective to create the final validated results of the Delphi survey. As input of the workshops a document has been prepared with the trends and policy instruments for the different policy domains. The lists of trends and policy instruments are split in important and less important subjects. This ordering was obtained by an analysis of the priorities given by the respondents of the first and second questionnaire.

The following questions were asked to the experts in the workshop:

1. Review, add and specify the given list of more important and less important trends.
2. Indicate the most important trends
3. Review, add and specify the given list of more important and less important research themes and related policy instruments.
4. Indicate the most important research themes and its most relevant research questions to answer in trans-national cooperation in transport research programming

For efficiency reasons the participants were asked to work in two sub groups in parallel, each on half of the policy domains. The participants were free to add new items to the existing list. After the discussion and completion of the lists, the participants could give priorities to the different items. The most important items were discussed and a summary of the discussion was written down. In the following sections describe the result of these discussions.

### 3.3 Policy domain Equity and Accessibility

#### Summary

General trends in society seen as most important are the ageing population, social exclusion, the secondary effects of road pricing and the reduced urban accessibility. The challenges offered by these themes are partly taken into account by policy goals like the improvement of urban passenger transport and reliable urban accessibility. Knowledge development and decision support systems are recommended to facilitate the introduction of road pricing and to manage urban sprawl.

#### Trends

In the phase 2 of the Delphi questionnaire 3 important trends have been identified:

1. Redistributive effects of pricing of infrastructure
2. Ageing of the population
3. Urban centres becoming less accessible.
4. The workshop participants added another important issue: Social exclusion:

Other trends that are seen as less important are

1. Deteriorating public transport
2. Growing car dependency due to land use and transport trends
3. Increase of agglomeration forces and regional inequality with decreasing transport costs
4. Urban sprawl provokes an increase in transport volumes
5. Accessibility for people without car decreases
6. City sprawl

During the workshop the most important trends were discussed and specified:

1. Redistributive effects of pricing of Infrastructure
  - Pricing will be important for a lot of future transport problems;
  - Politicians are afraid for pricing of infrastructure
  - Car users pay more for using infrastructure than train users;
  - Pricing in UK is focused on congestion redistribution
2. Ageing population.
  - Older people are less able to move around;
  - There will be a need for future population characteristics for younger and older people;
  - Changes in social/economical structure of city centres
  
  - We have to know more about user expectations;
  - We need methods to know more about chances in older/younger characteristics
3. Urban centres become less accessible
  - We don't know the structure in the cities (working and living)
  - The dynamic of the cities – migration out of the city (rich people) – immigration youngsters and old people;
  - Land use and role of city centres changes – retail out of city

4. Social Exclusion
  - Travellers with no money, no physical possibilities are depending on Public Transport
  - Social-Exclusion have to be on the political agenda

### Research themes and topics

The Delphi questionnaire gave 4 important policy issues:

1. Improve urban passenger transport;  
for this policy goal the following instruments were identified
  - New transport technology, e.g. Personal Rapid Transit
  - Information awareness
2. Reliable urban accessibility;  
with policy instrument Intelligent Transport Systems and Services, e.g. Integrated traffic management around cities (highways and urban roads).  
Another, less important policy instrument is:
  - Multimodal accessibility
3. Acceptance of road pricing;  
with as instrument Information awareness to stimulate the process of acceptance
4. Relation between accessibility and economic growth  
For this issue decision support tools are needed

In the workshop these issues were further analyzed and prioritized. In order of priority the policy issues are:

1. Improve (urban) passenger transport (top priority)
  - Not only focussing on urban passenger transport;
  - New forms of urban transport with integration of services and information
  - Real time information systems and managing of systems
  - Seamless system (multi modal) with integration of systems, information and charging; this option needs a money budget
  - Optimise the way you put the money in the transport system
2. Reliable (urban) accessibility (intermediate priority)
  - Distinguish different transport motives
  - Specification: Intelligent transport systems an services
  - Integrated Transport Management instead of Traffic Management only
  - Which accessibility is reasonable – understand the expectations of the users

From Less Important to Important

- Advanced urban traffic management around cities
- Multi modal accessibility by regulation and deregulation of Transport
- Who is the owner of the transport system and how to get an effective transport

3. Acceptance of Road pricing – charging (intermediate priority)
  - Clarify the goal of road pricing: generation of money or managing of the transport system (or both);
  - Quantify the different options; what are the real costs for the transport system?
  - Information and awareness research, i.e. understand the behaviour and response on several circumstances to modify the system; attitude of politicians and how they react on changes in the system
4. Relation between accessibility and economic growth (low priority)
  - Specification: Decision support system:
  - Infrastructure provision for all modes of transport
  - Understand the reasonable expectations of the infrastructure
5. Managing urban sprawl = Land use (low priority)
  - Specification: Regulation on long term:
  - How is Land use linking to transport
  - Relation urban sprawl and increase in transport

### ***3.4 Policy domain Economic development***

#### **Summary**

Changes are emerging in regulation and market development. Transport pricing is an example. The dependency on oil has important consequences. The change of the economy by a shift of production will also be important. Knowledge is needed about impact of the trends and to convince politicians about the need for measures. Further development of better and cheaper maintenance of transport infrastructure is an important direction of development.

#### **Trends**

In the phase 2 of the Delphi questionnaire 6 important trends have been identified: Increase in trade within the EU gives rapid increase in freight transport volumes

1. Opening market in Europe
  - Changing way of pricing transport and investing
  - Increasing goods transport needs
2. Division of work, increase in productivity and raise in private consumption in the new EU member states gives rapid growth in passenger transport
3. Global thinking
4. Lack of European transport data, seen as an increasing problem
5. Higher value of average shipment in freight transport
6. Increased product diversity and division of work leads to increased transport intensity in commodities

Other trends seen as less important are:

1. Internationalisation of economies of scale and increasing freight transport
2. Services oriented economy
3. Lack of public money, new forms of funding
4. Increasing prices of oil
5. Rising costs of infrastructure maintenance
6. Shift of production from Europe to China
7. Hydrogen economy
8. Privatization
9. GDP growth rates 2-2.5% per annum
10. Growing number of elderly
11. City sprawl

During the workshop some important trends were discussed and specified: Global thinking (3)

- Trend 1.b2: Changing way of pricing is also a sub of this trend;
- Multinational control and 24 hours economy;
- Industry replaces product all over the world.

*1.b<sup>2</sup> Changing way of pricing*

- Lack of Public money, new forms of funding (was Less Important 3) becomes a sub

The participants gave special attention to the trends

1. Increase in trade within the EU gives rapid increase in freight transport volumes
  - Changing way of pricing transport and investing
2. Division of work, increase in productivity and raise in private consumption in the new EU member states gives rapid growth in passenger transport
3. Global thinking

*6.<sup>2</sup> Shift of production from Europe to China*

- EU is less competitive market by over-regulation.

### **Research themes and topics**

The Delphi questionnaire gave 3 most important policy issues:

1. New regulatory measures, e.g. privatisation of roads, development of decision making tools and increasing awareness
2. Market development for road pricing, with important instruments like: Infra provision, pricing schemes and electronic toll collection technology
3. Change of the oil production and availability in the future, for which instruments are needed like: Decision support tool (Models for predicting impact oil prices), Vehicle technology (More efficient propulsion; Alternative fuels) and Pricing measures (Initiatives for improved fuel efficiency; voluntary agreements with manufacturers)

---

<sup>2</sup> The numbering refers to the numbers of the trends as listed above

The following policy issues were seen as less important:

1. Optimize maintenance of infrastructure, e.g. by road surface technology and systems for automated maintenance
2. How to have all costs paid by the transport users for all modes; here a need exist for tools to predict the impact of different pricing schemes
3. How to cope with shift of production
4. How to deal with aging population, a need for infrastructure provision and financial instruments
5. Fair and efficient pricing policy

During the workshop some of these policy issues (1, 2 and 3 from the priority list, 3, 5) have been further analyzed and prioritized.

1. New regulatory measures (top priority)
  - Privatisation not only roads but the infrastructure and services  
In relation with the market development for road pricing on a EU-level
  - Policy goal: How to have all costs paid by the transport users for all modes is a sub of 1.  
Specification: Privatisation
  - Unclear outcome of privatisation benefits
2. Market development for road pricing (top priority)
  - In relation with new regulation measures on EU level (see 1)  
Specification: Infrastructure Provision
  - Need for a framework for Organisation and responsibility issues
  - Outcome have to be agreed on political level
3. Change of the oil production and availability in the future (top priority)  
Specification: Decision support tools
  - The cost of distribution could become substantial. There will be a need for the identification of the cost of transport;
  - In which way consumers will respond on real costs of transport?

Low priority issues are (numbering refers to the list of less important trends)

1. Optimise maintenance of Infrastructure (low priority)  
Specification: Infrastructure provision
  - Road surface technology
  - Realisation work shorter in time
2. How to cope with shift of production
  - Construction of new (road) infrastructure for transport  
Specification: Infrastructure
  - TEN's, Flexibility will be a necessary.
  - Need for to know what and when is happening – modelling options for new point of productions (In depth study in next phase of ENT)
  - Need for regulation

3. Fair and efficient pricing policy  
Specification: Technology (and ITS)
  - GPS/Galileo for all modes of transport  
Specification: Studies orientated on global constraints
  - Development of regulation standards

A new policy goal was identified during the workshop

How to cope with rising Oil price (low priority)

Specification: Information and awareness

- Effect on choice of patterns in good and passenger transport all over the world

### **3.5 Policy domain Safety and Security**

#### **Summary**

Most important trends in society are improvement in safety and security in traffic and Internet. Perceived safety is still a problem, while different monitoring systems are introduced for automated surveillance and tracking and tracing. Still there are challenges such as the need to protect the most vulnerable users and to avoid negative consequences of technological innovations. Several instruments are seen as effective to realise the policy goals. Technological means in the car and in the environment, all kinds of ITS applications like advanced driver assistants and GPS.

#### **Trends**

In the phase 2 of the Delphi questionnaire 3 important trends have been identified:

1. Payment by Internet are becoming more secure
2. Growing awareness that benefits of measures to improve safety are higher than the costs
3. More confidential information is going through Internet
4. Intelligent in-car systems, including automatic driving as the end of the development
5. Traffic safety

Other trends, that are seen as less important are

1. Security of transport systems is becoming more important
2. Growing impact of failure of the system
3. Increasing international traffic
4. Aging people, old drivers etc

Comments made at the workshops are (numbers refer to the trends list):

4. Intelligent in-car systems
  - These systems give improving safety but may bring new risks too
  - Automatic driving is a part of it
5. Traffic safety
  - Traffic safety per car increasing (generally) Risk is decreasing

7. Ageing People old drivers etc.

- Extra: Vulnerable road users are not getting the safety benefits

Some new trends were identified:

1. Tracking and Tracing will become more important
2. Increasing perception of less social safety in Public Transport
3. Increasing surveillance on Public Transport
4. Increasing security measures on transport systems (security for terrorism) to increase perceived security?

### Research themes and topics

The Delphi questionnaire gave the following policy issues

1. Traffic safety by advanced driver support systems
2. Protecting transport consumers by vehicle technology
3. Internet security
4. Reliable transport by ITS, e.g. traffic management strategies and travel information

Less important issues are

1. Obedience to rules in traffic by application of ITS for traffic monitoring.
2. Attitudes
3. Safety of passengers
4. Impact of failure

During the workshop some of these policy issues (1 and 2 from the important list, 1 from the less important) have been further analyzed and prioritized. From the group 'important research themes' the following subjects were chosen (numbers refer to the research theme list):

1. Traffic Safety (top priority)
  - Transport technology
    - Advanced driver support systems
    - Collision avoidance systems
    - Enforcement
    - Introduction Black boxes
  - Information and Awareness
    - Accident databases and Training new systems
  - Monitoring transport of dangerous goods
    - GPS systems
2. Protecting transport consumers (low priority)
  - Integration of Transport and Infrastructure systems
    - Information systems
    - Acceptable safety levels for the introduction of new systems
  - Vehicle technology
    - Protection against theft and robbery, not only of cars, but also of consumers
3. Reliable Transport: Intelligent Transport Systems and Services
  - Traffic Management Systems
  - Travel Information
  - Safer user decision making systems

From the group 'less important research themes' the following subjects were chosen:

1. Obedience to rules in Traffic  
Legislation, Awareness and Information
  - Beware of the right level of acceptance
  - Traffic Monitoring as a part of Intelligent Transport

New policy goals and instruments are:

1. Understanding of the cost-effectiveness of safety by users and politicians (high priority)
2. Segregation of Transport Modes and Sector

### **3.6 Policy domain Efficiency**

#### **Summery**

Efficiency of transport systems can be improved by standardisation of different components, e.g. rail, pricing. Furthermore, the use of spare capacity, e.g. of roads and reduction of empty trucks and the integration of modes are seen as promising directions for development.

#### **Trends**

In the phase 2 of the Delphi questionnaire 8 important trends have been identified:

1. Growing transport flows between Middle European and Western European countries
2. More integration of Transport Services across modes
3. Growing goods transport needs because of globalisation
4. Regional approach of transport
5. Unreliability begins to come more important than congestion
6. Congestion begins to become less important than unreliability
7. Congestion infrastructure (roads, rail, airport and terminals), increased focus on efficient utilisation (pricing ITS etc) improvements in bottlenecks, etc.)

Other trends seen as less important are:

1. Increasing congestion
2. Improved energy consumption per pass\*km or ton\*km in road
3. Decrease of spare capacity
4. Cost of transport relative to income / shipment value falls
5. City sprawl
6. Support to national economy
7. Decreasing accessibility of economic centres
8. Increase of average journey length/ duration
9. Increased share of road and air transport

## Research themes and topics

The Delphi questionnaire gave the following important policy issues:

1. Interoperability of rail, e.g. Standardisation of intermodal transport units  
Systems to allow competing operators on rail infrastructure and Infrastructure capacity allocation
2. Robust transport infrastructure, for which decision support tools are necessary, and a classification of roads
3. Harmonisation of standards for transport means by regulation and standardisation of intermodal transport units such as mini containers
4. Improve quality of the transport system, e.g. by harmonising cross-cultural differences and advanced driver assistance systems
5. Global navigation systems, linked to dynamic models for traffic systems
6. TEN-T connection to new member states
7. Integration of transport services
8. Networking logistics (transport) centres

Other less important issues are

1. New time tabling for public transport
2. Use of spare capacity
3. Development Motorways Of The Sea
4. Regional traffic monitoring system
5. Integrated transport management and integration of land-use and transport management
6. Networking logistics (transport) centres

In the workshop the following research subjects were chosen and further elaborated: (numbers refer to the research item list)

1. Interoperability of rail (high priority)
  - Develop one standard European railway infrastructure; European safety and control for rail. One participant even suggested to abolish national railways.
2. Robust transport infrastructure
  - Suggested topics were incident management and the integration of different classes of roads.
3. Harmonisation of standards.
  - Develop standards for road pricing. Timetabling in public transport. Develop cross border timetables and slot allocation.
5. Global navigation systems.
  - Suggested were multi sensor monitoring and the development of traffic models coupled to GPS.

From the list of 'less important policy issues the following item was selected:

2. Use of spare capacity.
  - Suggestions were made for traffic information and how to deal with lack of robustness.

New subjects are:

1. Efficient use of infrastructure: developing standards for pricing. (high priority)
2. Improve quality of the transport system.
  - Suggestions were made for User-centered transport system; multimodal integration.
3. Reduce costs of transport.
  - Look at the freight transport market in the US. Reduce empty trucks. Improve DSS for logistics.

### **3.7 Policy domain User satisfaction**

#### **Summary**

The area of User Satisfaction is less structured as other policy areas. Many policy goals and instruments are also contained in other policy areas. This area has more the characteristic of giving emphasis to certain aspects of policy instruments, e.g. to include user quality in public transport contracts. Specific in this area is the demand for attention for tourism. Furthermore, there is a need for good information for the public about costs and benefit.

The transport users become more and more demanding where travelling time, information, reliability, costs and noise are involved. There is a certain trend noticeable which causes a change of segments to less traffic for people going to work and more traffic for leisure/tourism purposes.

Efficiency and economic development should imply the user satisfaction as the normative yardstick: efficiency is obtained if the user/taxpayer gets the maximum satisfaction for a certain level of expenditure is acknowledged.

#### **Trends**

In phase 2 of the Delphi questionnaire several trends were identified. Many of these trends were proposed by one respondent only and rated by the same person. That makes the prioritisation of these trends less inter-personal objective as in the other policy areas.

Important trends are:

1. Unsuccessful practice at external costs implementation as a tool for the modal shift towards the railway, combined and inland water transport
2. More complicated and valuable products, more reliable freight transport is demanded
3. Foster open markets in Europe (belongs to other policy area)
4. Foster awareness for European spirit and needs
5. Efficiency and economic development should imply the user satisfaction as the normative yardstick; efficiency is obtained if the user/taxpayer gets the maximum satisfaction for a certain level of expenditures!!

Less important trends are:

1. Concentration /Monopolization in the transport industry
2. Real – time Dynamic User information systems
3. Awareness of transport costs and benefits - supply and demand
4. More demanding customers (transport users)
5. Need for traffic information
6. More congestion, bottlenecks

7. Increase of tourism (using own car)
8. More educated and demanding citizens, demand higher quality in passenger transport
9. Need assistance and understanding of elderly and disabled
10. Calculating users want even more quality

During the workshop the following trends were discussed (numbers refer to the trend list):

1. Unsuccessful practice at external costs implementation
  - a tool for the modal shift towards the railway, combined and inland water transport were not seen in relation to user satisfaction. It should belong to another area.
2. More complicated and valuable products, more reliable freight transport is demanded
  - the same goes for passenger transport: high value of time

Less important issues discussed in the workshop are (numbers refer to the less important trend list):

2. Real-time dynamic user information systems
  - This is connected to the important policy instrument 2 (increase comfort of passengers)
  - Awareness of transport costs and benefits  
One should become more aware of supply and demand
4. More demanding customers (transport users)
  - Increase of Tourism (using own car)
  - More educated and demanding citizens, demanding higher quality in passenger transport is acknowledged as such.
9. Need assistance and understanding of elderly and disabled.
10. Calculating users want even more quality.

### ***Research themes and topics***

The policy goals found in the second phase of the Delphi questionnaire are:  
Important:

1. Quality aspect in freight transport with respect to monopolization
2. How to increase the comfort of the passengers, e.g. by dynamic traveller information
3. How to strengthen the safety of the passengers (vehicle technology)

Less important

1. Harmonisation of the procedures throughout EU
2. User as a consumer
3. Internalisation of external costs
4. Utilisation of the revenues as a support for more environmental friendly transport modes
5. How to improve the services by the Internet
6. Quality aspects in passenger transport
7. Disobeying traffic rules

The research themes selected by the participants are:

1. Harmonization of the procedures throughout EU (high priority)
2. Tourist travel; Identify specific requirement (medium priority)

3. Strengthen safety; infrastructure improvement (medium priority)
4. Safety; ADAS (medium priority)
5. Traffic rules; Situation dependent rules (medium priority)
  - simplification/reduction of signs & rules
6. Quality PT; Contracts should include all kinds of quality aspects (medium priority)
7. Comfort;
  - less interchanges between modes (low priority)
  - Improve transport related internet services
8. Awareness Cost/benefit;
  - study to show external effects
  - relation between tax and destination
9. User as a customer

### **3.8 Policy domain Environment**

#### **Summery**

Air quality and noise pollution are very serious traffic related problems that deserve more attention. The limited approach, e.g. the limitation of noise en emission to road traffic and the focus on CO2 neglects important problems and opportunities for improvement. The technology seems to be available, but the introduction in practice requires more attention.

#### **Trends**

In the Delphi questionnaire the following trends were identified:

Important:

1. The international agreed CO2 reduction cannot be achieved
2. Long term trend increasing CO2 emissions in transport and growing share of transport

Less important were

1. Vehicle emissions reduced to EU 4 standards
2. Local air quality in urban centres reaches worrying levels
3. Growing noise problem
4. It will not be possible to lower the advantages of the road transport over the rail transport
5. Environmental catastrophes will increase awareness
6. NO2 is a significant air quality problem because of the high share of diesel vehicles
7. The shortage of oil and development of improved and new technology leads to more energy efficient and environmentally friendly transport, This solves the local traffic pollution but the CO2 reduction is more than offset by rapid transport growth
8. Increase in noise nuisance
9. It becomes more difficult to build infrastructure due to environmental reasons

### **Research themes and topics**

The policy issues for this domain are important:

1. What can and should be done with air pollution by transport, basically by vehicle technology and regulation
2. How to reduce CO<sub>2</sub> emissions by transport: alternative propulsion and fuel, and pricing (emission trading)
3. How to reduce noise emission by vehicle technology

The participants of the workshop discussed the trends and gave the following opinions:

1. Increased awareness of citizens of environmental problems
  - Local air quality is considered to be a bigger problem than CO<sub>2</sub>.
2. How to deal with air pollution and reducing CO<sub>2</sub>-emission caused by transport? \ul>- They are considered too big for interregional solutions only.
3. Vehicle emissions reduced to EU 4 standards.
  - There is an impact of existing technology/vehicles on improvements in vehicle technology.
4. Local air quality in urban centres reaches worrying levels.
  - One should develop tools to predict air quality impact of traffic measures. There should be regulations for all vehicles, based on sound research for all modes. One could use traffic measures to meet air quality limits in urban zones.
5. Growing noise problem.
  - One could use feedback control of speed limits. In case of noise and visual problems one could think of separation transport infrastructure from residential areas (tunnels). In case of noise and emission one could think of reducing emission of aircrafts (too).
6. Market penetration of new technology: this is an important subject concerning technological improvements

The policy issues and instruments that are chosen for the environment area are:

1. What can and should be done about air pollution by transport: Alternative fuels, propulsion systems (high priority)
2. Air quality: Consistent regulations for all vehicles, based on sound technological state of the art (high priority)
3. How to reduce noise emission: Technology of silent vehicles (high priority)
4. How to reduce noise emission: Alternative propulsion, silent tyres, silent asphalt (High priority)
5. Noise & emission: reduce emissions from aircrafts too (average priority)
6. Noise + visual; Separation transport infra in residential areas (tunnels) (low priority)
7. How to reduce CO<sub>2</sub> emissions by transport: Clean engines, alternative fuels
8. Air quality: Tools to predict air quality and tools to predict impact of traffic measures

## 4. Research conclusions

This chapter presents the conclusions of the Delphi survey. Paragraph 4.2 gives some general conclusions regarding the process and the content. Next an overview is given of differences in the responses of experts of old and new member states. In the final paragraph the research themes and questions given by the experts are related to the relevant policy instruments to identify the themes for discussion in the Research Policy Seminar.

### 4.1 General conclusions

In total 28 experts from 18 different countries and international organisations participated in the survey. The Delphi questionnaires did not result in very surprising research subjects. In general at least about 30 respondents are needed to make the result of questionnaires like this sufficiently reliable. The size of the initial group (50 possible respondents) was sufficient, but the response rate (40%) is slightly less than the optimal number of independent opinions. The number of respondents in the second phase is rather low to be sure about the completeness of the lists of policy instruments. A larger group of respondents would certainly have given more research topics and prioritization that was more certain. However, the professional quality of the respondents was very high. The final step in the Delphi survey, the workshop, has strengthened the validity of the results of the questionnaire.

Certain research questions were raised that are certainly important. One may observe that the more functional policy domains, like accessibility and economy give clearer prioritizations than issues like user satisfaction and environment. The conclusion from this general conclusion should certainly not be that more attention should be given to the well-ordered and prioritized policy domains. On the contrary, much emphasis should be given to clarify the research priorities for the themes that are still fuzzy.

### 4.2 Differences between old and new member states

The interests of new member states and their priorities might be different from the ones of the old member states, since there are differences in the development and consequently there might be different urgencies of problems. In a part of the questionnaires this difference in priorities and vision could be observed. The following differences have been identified:

- The old member states give a higher priority to fair and efficient pricing policy, a market development for road pricing and the need to let all transport users pay for their costs.
- The old member states are more concerned about the future of oil production and availability
- The new member states give a high importance to interoperability of rail (this conclusion is based on very few observations) and the TEN-T connections, harmonisation of standards, new time tabling for public transport, the development of global navigation systems

- The old member give on the general a higher value to regional cooperation than the new member states, also on subjects that the new member states find important for the present situation.

One may get the impression that the tradition of the old member states to have international cooperation in research might be stronger than for the new member states. The old member states representatives seem more inclined to think of trans-regional cooperation as the new member states do.

#### ***4.3 Integration of policy instruments and research themes and topics***

The policy domains structure the presented results in this report, based on the structure of the questions in the questionnaires and workshop. To identify the research themes and questions, related to the policy instruments, a restructuring is possible. In total 9 actual policy instruments are to be identified. The table below presents the research themes and questions put forward by the experts in relation to the policy instruments. At the same time the relation of the research themes and topics with the relevant policy domain is presented in the same table.

The 9 policy instruments, with the related research themes and topics, will be used to structure the discussion in the Research Policy Seminar to identify the future themes for transport research programming in more detail

**Table Integration of policy instruments and research themes and topics**

<b>Prioritized policy instrument / research theme specified with topics</b>	<b>Economy</b>	<b>Efficiency</b>	<b>Environment</b>	<b>Safety and security</b>	<b>Equity and accessibility</b>	<b>User</b>
<b>VEHICLE TECHNOLOGY</b>						
Advanced Driver Assistance support system – E.g. Collision avoidance systems				X X		X
Protecting Transport consumers – Integration Systems Vehicle Technology - Impact of Failure (protect pedestrians) – Against theft and robbery (cars, goods and consumers)				X X X X		
Alternative propulsion, fuels and silent tyres - How to reduce noise emission: Technology of silent vehicles - Reduction air pollution by transport			X X X			
Noise & emission: reduce emissions from aircrafts too			X			
<b>TRAFFIC AND INFRASTRUCTURE MANAGEMENT</b>						
Improvement of (urban) passenger transport system - New public transport with integration service and information					X X	
Comfort; less interchanges between modes						X
Integration transport services; multi modal info systems		X				
Improve quality transport system; user centred system		X				
Contracts of public transport should include all kinds of quality aspects						X
Reliable urban accessibility: - Advanced traffic management around cities - Multimodal urban accessibility					X X X	
Robust transport infrastructure; management of incidents		X				
Use of spare capacity; how to deal with lack of robustness		X				
GPS and Galileo for all transport modes	X					
GPS and Galileo for all transport modes	X					
GPS for tracking of dangerous goods				X		
Traffic models coupled to GPS		X				
(Multi-sensor) traffic monitoring		X		X		

<b>Prioritized policy instrument / research theme specified with topics</b>	<b>Economy</b>	<b>Efficiency</b>	<b>Environment</b>	<b>Safety and security</b>	<b>Equity and accessibility</b>	<b>User</b>
Traffic management systems				X		
Tourist travel; Identify specific requirements						X
<b>REGULATION AND DEREGULATION</b>						
Harmonisation of the Procedures throughout EU						X
New regulatory measures for privatisation of infrastructure	X					
Regulation standards	X					
Air quality: Consistent regulations for all vehicles, based on sound technological state of the art			X			
Simplification and reduction of traffic signs and rules						X
Interoperability of rail; systems allowing competition		X				
<b>DECISION SUPPORT TOOL</b>						
DSS for influence of availability of oil in the future	X					
Relation between accessibility and economic growth					X	
Air quality: - Impact of traffic measures on air quality - Tools to predict air quality			X X			
Study to show external effects and relation between tax and destination						X
Understand the Cost effectiveness of safety by users and politician				X		
Black boxes for driver monitoring				X		
Safe user decision making systems				X		
Understanding of impact higher oil prices on decisions in goods and passenger transport	X					
<b>INFRASTRUCTURE PROVISION</b>						
Optimise Maintenance of Infrastructure	X					
Road surface technology	X					
Realisation of road works in less time	X					
How to reduce noise emission: silent asphalt			X			
Separation of traffic infrastructure in residential areas (tunnels)			X			

<b>Prioritized policy instrument / research theme specified with topics</b>	<b>Economy</b>	<b>Efficiency</b>	<b>Environment</b>	<b>Safety and security</b>	<b>Equity and accessibility</b>	<b>User</b>
Robust transport infrastructure - Integration different classes of roads		X				
Connection new member states; development of new infrastructure		X				
Strengthen safety; infrastructure improvement						X
Infrastructure for road pricing	X					
<b>INFORMATION AND AWARENESS</b>						
International standards for timetabling of public transport		X				
Travel information systems				X		
Improve transport related internet services						X
User as a customer						X
Information for improved urban transport					X	
Accident databases				X		
<b>PRICING AND TAXATION</b>						
Acceptance of road pricing						X
Fair and efficient pricing policy – Technology	X					
TEN-T Infrastructure fee		X				
<b>LAND USE PLANNING</b>						
Managing urban sprawl					X	
Integration of transport management and land use policy; model for land use/transport		X				
<b>INTEGRATION OF TRANSPORT SYSTEMS</b>						
Acceptable safety levels for the introduction of new transport systems				X		
Interoperability of rail; systems allowing competition		X				
Interoperability of rail; European safety & control		X				



## Appendix 1

### Participating experts in Phase 1 of the Delphi survey (questionnaire 1)

Experts	Institute	Country/Organisation
Mr. T.D. Aphasimis	Ministry of Communications and Works	Cyprus
Mr. P. Christidis	Joint Research Centre (JRC)	European Commission
Mr. Prof. Dr. A. Chudzikiewicz	Warsaw University of Technology	Poland
Mr. V. Fencel	Transport Research Centre (CDV)	Czech Republic
Mrs. S. Gayda	Stratec s.a.	Belgium
Mr. Prof. Dr. G.A. Giannopoulos	Aristotle University of Thessaloniki	Greece
Mr. A. de Graaff	National Aerospace Laboratory (NLR)	Netherlands
Mrs. L. Hakamies-Blomqvist	National Road and Transport research Institute (VTI)	Sweden
Mr. K.W. Johansen	Institute of Transport Economics (TOI)	Norway
Mr. Prof. Dr. H. Keller	Transver	Germany
Mr. Dr. A. Kopp	Joint Transport Research Centre	OECD/ECMT
Mr. K. Lautso	LT Consultants	Finland
Mr. H. Luikens	Joint Transport Research Centre	OECD/ECMT
Mr. J. Mikula	Transport Research Institute	Slovakia
Mr. K. Petersen	Transport Research Institute	Denmark
Mr. Prof. Dr. E. Pucher	Vienna University of Technology	Austria
Mr. Prof. Dr. P. Rietveld	Free University Amsterdam	Netherlands
Mr. Dr. A. Sakalys	Vilnius Gediminas Technical University	Lithuania
Mr. P. Velhonoja	National Road Administration	Finland
Mr. Prof. Dr. G.P. Van Wee	Technical University Delft	Netherlands

## Appendix 2

### Participating experts in Phase 2 of the Delphi survey (questionnaire 2)

Experts	Institute	Country/Organisation
Mr. T.D. Aphas	Ministry of Communications and Works	Cyprus
Mr. P. Christidis	Joint Research Centre (JRC)	European Commission
Mr. Prof. Dr. A. Chudzikiewicz	Warsaw University of Technology	Poland
Mr. J. Grébert	Renault Research	France
Mr. Prof. Dr. K. Henning	RWTH Aachen University	Germany
Mr. K.W. Johansen	Institute of Transport Economics (TOI)	Norway
Mr. Prof. Dr. H. Keller	Transver	Germany
Mr. Dr. A. Kopp	Joint Transport Research Centre	OECD/ECMT
Mr. H. Luikens	Joint Transport Research Centre	OECD/ECMT
Mr. J. Mikula	Transport Research Institute	Slovakia
Mr. Dr. R. Pfiagl	Via Donau	Austria
Mr. Prof. Dr. G. Sammer	University of Natural Resources and Applied Life Science	Austria
Mr. P. Velhonoja	National Road Administration	Finland
Mr. F. Walter	Ecoplan	Switzerland
Mr. Prof. Dr. G.P. Van Wee	Technical University Delft	Netherlands

## Appendix 3

### Participating experts in Phase 3 of the Delphi survey (Workshop)

<b>Expert</b>	<i>Institute</i>	<b>Country / Organisation</b>
Prof. A. Chudzikiewicz	Technical University Warsaw	Poland
Mr. B. Jansen	TNO	Netherlands
Mr K.W. Johansen	Institute of Transport Economics	Norway
Mr. H. Kanner	VTT Technical Research Centre	Finland
Prof. Dr. Ing. H. Keller	TRANSVER	Germany
Prof. M. McDonald	University of Southampton	Great Britain
Prof. Dr. E. Pucher	Technical University Vienna	Austria