SCENES

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SCENES European Transport Scenarios
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INTRODUCTION

The SCENES project covers the follow-up research for the Areas 10, 11 and 12 in the Phase B of the Strategic section of the 4th Framework Transport Research Programme (FP IV) of DG TREN. The work was organised into three separately managed Work Areas (WAs), corresponding to Areas 10, 11 and 12.

There were many original objectives of the SCENES project, spanning as it did a wide range of subjects and involving a large consortium of 18 partners. The main objectives and the WAs in which they are located are summarised as follows:

- to develop a databank of variables, covering EU countries and a range of countries in Eastern Europe (WA 10)
- to develop detailed forecasts of factors which will affect transport demand into the future, incorporating institutional factors and studies on breaks in trends. (WA 10)
- to extend to Eastern Europe and enhance with new data a strategic transport model of the EU and to carry out model runs based on the scenarios - this model will be linked to an "appended" logistics module (WA 11)
- to produce transport demand scenarios for the EU for 2020 and beyond. These scenarios are made up of external, socio economic scenarios, and sets of policy scenarios (WAs 11 and 12)
- (existing) regional transport models will also be run to study the impacts of different scenarios (WA 12).

These objectives have been met in the course of the project. The tasks carried out in each of the WAs are now outlined in turn.

WA 10

The SCENES Internet Database has been set up, which contains base year data for 35 European countries and 31 indicators at the regional level as well as socio-economic forecasts generated within SCENES. This database has enabled an information system which focuses on socio-economic and transport demand-influencing indicators for European regions to be established. It has become a unique, easily accessible, data platform for socio-economic data at the regional level. Experience within the SCENES project has shown that from the transport modellers' point of view, there is a definite need for such a reliable, transparent and user-friendly database system to access regional socio-economic data.

Due to unsolved copyright problems the SCENES Internet Database has so far been accessible only for SCENES project partners and the European Commission. However, many of the transport research projects carried out in Europe depend on data from the same set of socio-economic indicators. Therefore, it would be very helpful to have a *common* and *consolidated* data platform for socio-economic data at the regional level. The establishment of such a medium would not only harmonise the input data for the models applied (and therefore the output of the models as well), but might also be useful in terms of saving resources. By providing a common data platform for research projects, repetition of data mining (which is a time-consuming process) could be avoided. From this perspective, the SCENES Internet Database may serve as a first, but decisive step on the way to a pan -European data information system, with regional (socio-economic) data, whose content is not only relevant for transport modellers, but also for policy-makers and other researchers undertaking regional analyses.

The second main area of research within Work Area 10 has embraced the analysis of drivers of transport demand concerning the following topics:

- generation of forecasts for socio-economic indicators for the year 2020 at regional level and for 2040 at national level
- study on interactions between demand and supply in transport
- analysis of impacts of regulatory systems in the transport sphere
- analysis of changes in trends of transport demand
- research on institutional aspects.

Detailed investigation of the drivers of transport demand has shown that the demand for transport is not solely influenced by the factors that are usually included in transport modelling, such as preferences for mobility, sectoral development of production, or transport supply characteristics. In order to explain long term changes in transport patterns it is also necessary to study the demand/supply effects, which occur in second round interactions between *land-use changes and transport development.*

Another area of great influence on the long term development of transport patterns is the type of *regulation* of the different transport sectors. However, in most cases the regulatory changes within public transport have not led to a substantial increase of patronage, but rather to faster rationalisation and more cost efficiency on the supply side. Without direct initiatives towards the harmonisation of transport markets it is unrealistic to expect substantial shifts from individual motorised transport to public transport.

On the contrary, due to the liberalisation process in the road freight and the airline sector in the European Union, further strong impulses have been given towards those sectors, despite all concerns expressed in Green and White Papers on the environmental consequences of such developments. Looking at the railway sector in some detail one can – after studying the performance of different regulation activities in individual Member States – draw the conclusion that these activities had little effect on changing the trends of traffic development. In the case of long distance transport, the reasons for this are that market conditions have not yet been harmonised, and that strong national barriers still exist which hamper the development of international railway operations.

Large external changes, like the transition process taking place in CEE countries, have been able to provoke *changes in trends* in transport demand patterns, whereas other less striking external disturbances have only resulted in a temporary discontinuation of prevailing trends. Thus the analyses of changes in trends suggest the conclusion that: whenever policy-makers intend either to achieve permanent changes from the current trends in transport demand growth, or to achieve decoupling of certain transport demand indicators from economic development, then major and extensive efforts will certainly be required.

The *institutional framework* within which transport markets are embedded has proved of great relevance to the development of transport. The institutional framework provides the guidelines for how externalities are dealt with and for how incentive mechanisms are set. It also tackles the problems associated with transaction costs. Thus institutional aspects determine not only the allocation of costs to certain modes, but also the way transport is organised and operated. Thus it has decisive impacts on reliability, quality, efficiency and security of transport services and thereby on transport demand patterns and the relative competitiveness of modes. Although it is rather complex to demonstrate their effects on transport demand indicators, institutional aspects are an important driving factor of transport demand.

WA 11

The main task in WA 11 was the construction of the SCENES European-wide transport forecasting model. The SCENES model is a network based model of all movements on all transport modes for

both passengers and freight, and it also includes intermodal transport. It uses data and analysis from WA 10, for example, the WA 10 forecasts of socio-economic variables. It has been run to test various policy scenarios for analysis within WA 12.

The SCENES transport model comprises separate passenger and freight demand modules, and a compatible passenger and freight transport model. It is a development of the model created during the preceding STREAMS FP IV project for DG TREN.

The structure of the SCENES model is in essence that of a traditional four-stage model, with distinct Generation – Distribution – Modal Split – Assignment components. However, the costs and times of travel which are output from the transport model feed into the demand model in the form of "disutilities" (derived from zone-pair travel costs and times)– thus the system encompasses a full feedback between the two models. In this way, changes in the transport model, be it through transport cost or infrastructure changes, have a bearing on the demand for travel.

The model is designed to produce in the first instance European level transport forecasts. Comprising as it does of a wide range of demographic, economic, socio-economic and transport factors, and being built as a 'bottom up' model from the zonal level, a much greater level of spatial detail is however possible, and indeed many country and sector specific results are reported in the project. This level of detail can be achieved because the model comprises all transport and travel, including very short distance trips and slow modes.

The 15 European Union countries and eight Central and Eastern Europe Countries (CEEC) comprise the 'internal' modelled area. That is, all travel within this area is modelled. The rest of the world is treated as 'external', i.e., passenger travel and freight traffic to and from these external zones is modelled. The internal modelled area is represented by 244 zones based mainly on the NUTS2 definitions, and the external area is represented by 17 'European' zones with 4 zones representing the rest of the World. The exception is that freight traffic within the CEEC area is not modelled – only freight traffic between the CEEC and the EU, i.e., only the EU15 countries are treated as internal for the freight model.

The ***passenger demand*** model combines highly segmented, zonal level socio-economic and behavioural data to produce a matrix of travel. There are 20 population groups specified in each zone and 10 trip purpose categories. The ***freight demand*** model is based on a spatial adaptation of a financial input-output structure, in order to represent linkages between industries. These inter-linkages are estimated from zonal final demand. Some 24 economic sectors are used in producing a matrix based on value, which is converted to volumes in an interface module. This freight volume matrix can be combined with the passenger travel matrix and assigned to the modal networks in the common transport module.

The ***transport model*** contains a representation of the costs and times of travel by all the different modes (at the country level) between all of the model zones, for passenger and freight traffic. This is achieved using comprehensive and detailed multi-modal transport networks for road, rail, air, shipping, inland waterway and pipeline. An innovative treatment of intra-zonal travel for both passengers and freight allows the characteristics of even the shortest trips to be represented.

The purpose of the WA 11 work was to demonstrate the validity of the model structure, both in terms of the 1995 Base Year results, the 2020 reference case results, and the 2020 transport policy scenarios. These policy scenarios are designed to illustrate the nature of the forecasting process that can be undertaken with the model, rather than form a definitive set of European transport forecasts – in this way they do not constitute any "official" view of the future. In order to achieve the latter, forecasting assumptions and model outputs would have to be developed and analysed in much more detail, in the context of, and in consultation with, existing national level assumptions and forecasts.

WA 12

WA 12 explores specific scenarios and uses a set of modelling tools in order to show how alternative hypotheses might influence the transport system in the future.

It builds on the work realised in WA 10 on the collection of information and on the drivers of transport demand, and on the work in WA 11 on the development of a European-wide model. Based on a set of contrasting scenarios the WA 12 focuses on structural changes and spatial development patterns to explore how these affect the different components of the transport system. In that sense WA 12 provides a complementary approach to that in WA 11.

A variety of scenarios have been built up by exploring a series of different dimensions in separate work streams. Then the results of these have been drawn together in a coherent fashion. Scenarios can be produced to give a number of contrasting images of a future situation through the development of different hypotheses. Two major dimensions of the construction of scenarios have been distinguished in this study

The external (socio-economic) dimension: this comprises the range of external factors (economic, institutional, social, behavioural, technological, geographical) that will influences the future pattern of transport. To a large extent the evolution of these factors is outside the control of the transport policy maker, though they may be influenced by policy decisions outside the field of transport.

The transport policy dimension: this comprises the range of policy initiatives within the field of transport, e.g. pricing, regulation, investment, etc. that the transport policy maker may wish to explore.

Within the external dimension the two main aspects that have been investigated are:

- the **spatial** dimension of Europe and the regional spatial dynamics of an extended Europe. For this dimension two main spatial development scenarios were developed: one which is termed the "Euroland" scenario is a radial development scheme in which the industrialised core of the EU is the centre, the contrasting alternative scenario is a "multi-polar" scheme based on the revival of regional links within an enlarged European space
- the dimension of **structural changes in behaviour:** this includes both the behaviour of passengers through changes in car ownership and attitudes to car use, and the behaviour of companies through changes in their forms of organisation and logistics. For this dimension, two main behavioural scenarios were developed: one is termed the "Unrestricted", the alternative is the "Quality of Life" scenario.

The objectives of these two dimensions are to produce contrasting external scenarios on European spatial development, focusing on regional developments; and to analyse and test the implications of behavioural and structural change for passenger and freight transport in Europe.

In the construction of internally consistent scenarios reference is made to two major trends that are relevant to, but uncertain for the future. These trends provide a common framework for the various scenarios and have impacts on many behavioural changes:

- **Globalisation:** this corresponds broadly to the "Radial Development – Core of EU" spatial scenario and to the "Unrestricted" behavioural scenario
- **Regional integration:** this corresponds broadly to the "Multi-Polar Development" spatial scenario and to the "Quality of Life" behavioural scenario.

The trends are based on contrasting globalisation and liberalisation on the one side with local sustainability and protection of the environment on the other side.

This approach is illustrated through the development of transport policy scenarios concerning two major areas of EU policy: the enlargement of Europe towards CEEC countries, and the Transalpine case study.

- For the enlargement to the East, the policy scenario is a combined infrastructure and pricing scenario for the TINA (Transport Infrastructure Needs Assessment) corridors.

- For the Transalpine corridors, the policy scenario investigates harmonisation of national policies as well as initiatives to achieve an increase in rail modal share in order to reach a 50/50 road/rail balance for Transalpine freight crossings.

For both of these case studies specific transport models have been used: the VACLAV model for the TINA corridors, and the TRANSALP model which has been specifically built within the SCENES project.

The extension of East-West corridors from EU countries and major cities through to Eastern countries have also been chosen as application case studies in order to illustrate the spatial dimension for projections up to 20 or 30 years from now, and to show that a link can be made in the long run between a European vision of the future and concrete localised projects. The two corridors that were studied are

- Paris, Brussels, Berlin, Warsaw, Moscow
- Marseilles, Milan, Venice, Ljubljana, Budapest.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations from the range of tasks within the SCENES fall into three main groups: those concerning drivers of transport demand, those related to transport policy issues that have been derived through the development of scenarios and the use of analytical procedures, and those related to the analytical procedures themselves developed within the project.

Drivers of Transport Demand

The socio-economic forecasts generated within the SCENES project suggest that there are significant differences across Europe. The strongest dynamic of economic growth in Europe is expected to emanate from the accession countries and Eastern European countries, which in the long run will result in a higher level of parity of wealth and cohesion in Europe. A similar contrasting development is forecasted for car ownership growth.

The results of research on demand-supply interaction underline the requirement for an integrated transport policy, which is characterised by a consistent approach to handling the long-term interrelations between transport policy measures and land use, and which also pursues an integrated approach when designing policy measures in order to guide modal split in the required directions.

Other areas of great influence on the long term development of transport demand patterns is the type of regulatory scheme as well as the institutional framework in which transport markets are embedded. In the EU countries, changes in the regulatory systems and changes of organisation in the transport sector have been stimulated, in particular after 1985, in order to improve allocation efficiency and competitiveness. Different concepts for regulating and organising public passenger transport have emerged across Europe. Several case studies have shown that, in certain countries, regulatory change has gone in parallel with growing demand for public transport. This holds true in particular for the introduction of franchising systems rather than outright deregulation. However, in most cases the regulatory changes within public transport have not led to a substantial increase of patronage, but

rather to faster rationalisation and more cost efficiency on the supply side. Regulatory changes in CEE countries have been most effective for the mode road. The types of changes that have occurred related to the road mode can be summarised by demonopolisation (intercity passenger transport by coach operators), decentralisation (urban public transport) and deregulation (freight market). Generally speaking, deregulation in freight transport has been achieved quicker and on a wider basis than regulatory changes in the passenger market.

Analyses have shown that transport demand patterns have been driven by various developments, which are partly internal and partly external to the transport sphere. Both the external developments (e.g. progress of deregulation, institutional framework, changes in demand structures) and the internal developments (e.g. productivity and application of innovative information and communication technologies for transport operation) have acted in favour of the modes road and air but have been stacked against the mode rail. This is problematic since, in the opinion of many policy-makers, rail is the mode that most needs to increase if sustainable transport systems are to be achieved. The studies have shown that only radical changes in circumstances can provoke changes in the prevailing trends in transport demand patterns. Therefore in order to push certain modes, on the one hand comprehensive and integrated policy measures are required, on the other hand a high level of innovation is required on the transport operators' side.

External and Policy Scenarios

The key feature that becomes apparent from the diverse issues that are analysed in the external scenarios is the need for *flexibility* in the transport policies that may be developed. There are major political and social forces (particularly in the countries outside but bordering on the EU) that could radically alter the future travel demand pattern. Accordingly, transport policies should be such that, if and when major breaks in trend occur, the policy can be adjusted so as to still retain its original coherence.

Yes it is important to use good analytical tools to forecast the potential impacts of transport policy measures. However, it is also important that these policy measures do not rely unduly for their success on an ability to accurately forecast future external social and political events across Europe. Policy measures need to be robust to a range of possible future external scenarios.

The other main finding from the analysis of external scenarios is the importance of behavioural and structural change factors for households and firms in determining future transport patterns. Strategic transport studies need to look at a wide range of behavioural and attitudinal issues from outside the transport system that may have a major future impact on transport itself.

The main policy conclusions are drawn from the two transport policy scenario case studies that have been carried out.

The combined infrastructure and pricing scenario applied to the TINA corridors

The combined infrastructure and pricing scenario has shown that most parts of the road and rail infrastructure of the TINA core networks could be financed by charges on the users. However, when comparing the share of rail infrastructure assumed not to be built with the share of road infrastructure assumed not to be built, the approach that was applied of internalising the infrastructure costs, results in a higher share of rail infrastructure being shown to not be financially viable, than is the case for road infrastructure.

Summarising these results leads to the conclusion that the assumptions made in this policy scenario are ill-adapted to encourage the sustainable development of transport. Quite contrary to the goal of achieving more sustainability in transport, the assumptions of infrastructure building in this policy

scenario encourage higher market shares for the modes: private car and air but a decline in the rail share.

The second important finding from this study is that is has proved more difficult for the rail mode to finance its infrastructure from its users than is the case for the road mode. This is due to rail's higher infrastructure building costs and relatively high maintenance costs.

Policy scenarios for Transalpine freight

The clearest outcome of this study is that a new, supra-national, authority should be created, with the mission of co-ordinating global Transalpine issues linked with transport and the environment. This authority should lead to a better harmonisation of policy measures, infrastructure planning, realisation and operation amongst the Alpine countries as well as amongst countries influencing Transalpine transport. The main Transalpine freight issues this new authority should tackle are listed below.

Two interrelated measures would be needed to achieve a proportion of rail freight equal to that on road: first, all new Transalpine rail investment projects linking France, Switzerland and Austria to Italy are needed, not merely for the extra capacity, but also to enable high commercial rail speeds to be achieved; secondly, their realisation should be synchronised with the complete removal of institutional obstacles.

Analysis of the Transalpine relations in the database shows that countries far away from the Alps, primarily on the North-South corridor, are important traffic generators. Indeed, Alpine crossings regulate modal choice far upstream, and also the upstream modal choice influences the selection of the crossing point. Accordingly, the main origin and destination regions should participate – to some extent - to modal shift measures and/or to finance infrastructure. A legal structure has to be developed to enable this to occur.

Consequently, at the larger scale, national policies have to be harmonised with the objective of influencing traffic flows all along the international logistics chain: road freight should not be heavily charged in the locality of the Alpine regions, while at low cost on the rest of the continent.

New large-scale projects aimed at achieving globally more efficient and sustainable Transalpine transport should be financed trans-modally, seeking modal solidarity, over one or two generations, whereas the traditional (unimodal) long-term return on investment approach should be left to the case of local infrastructures, where modal choice is less appropriate. An official framework should be produced, with a clear definition of the objectives, in terms of sustainability, transport efficiency and finance.

Methodological developments

Perhaps the most important methodological outcome is the demonstration that a comprehensive transport model for Europe can be created, which validates well at the national level. Many innovative research features have been developed in the creation of this model.

The usefulness of this SCENES European model has been illustrated through:

- running the model to produce a reference case for 2020 that can provide a baseline set of future transport results across Europe for use as input to other studies
- testing a range of policy scenarios for 2020 on the future evolution of transport costs by mode, both for passengers and freight.

The main aspects in which this model would benefit from future improvements are:

- modifying the assignment procedure to adopt differential sampling of zone pairs in order to increase the level of spatial detail, especially on the road network

- provided that improved coverage and harmonisation of passenger and freight data across the EU can be achieved, the quality of the local calibration in the SCENES model could be improved through the use of this improved data.

This SCENES model is at its strongest when operating to represent strategic issues at the European-wide level, but currently is less suited to analyse specific small-scale initiatives in a particular locality.

In this study the SCENES model focused on policy testing within a single external scenario. In the future, other alternative external scenarios could be developed based on different assumptions regarding the evolution, for example, of GDP and car ownership growth and of the sectoral patterns of future trade. Likewise, a wide range of other transport policy scenarios (e.g. major infrastructure investment, regulation of road vehicle speeds, fuel taxation, etc., applied differentially to some or all regions or parts of the modal networks) could be tested across Europe using this model.

Another important topic in which the SCENES model could be of future value is through use of its comprehensive reporting capability to provide a future transport baseline as a foundation for European transport projections. The potential role of European transport projections is as an agreed background input to studies in related topics, such as energy usage, pollution emissions, accessibility and social exclusion. In the absence of agreed European transport projections such studies are forced currently to make their own projections (often of poor quality), with the resulting disadvantage that they rarely will be common across studies.

It is however clear that a single pan-European model is not sufficient to meet all policy testing and scenario development needs. Accordingly, a range of well-known models from different European countries has been put together within a common framework of analysis to explore behavioural and structural change issues. Each model highlights different specific aspects of the transport system. Through taking this partial modelling approach, in which only a particular corridor or a sub-set of travel movements is analysed in detail, it is possible to analyse the specific topics of interest in greater depth.

However, considerable care needs to be taken with models designed for a specific locality or purpose, when extending their results to provide more general insights across Europe. The ever-present danger when adopting and combining results from an array of different models is that their underlying assumptions and data definitions may differ significantly between the models.

This highlights the need for clear specifications of agreed baseline assumptions when defining scenarios. There is an important role to be played by DG TREN in the future in the development of an agreed baseline set of transport projections and assumptions for use both for studies within DG TREN and elsewhere.

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INTRODUCTION

The SCENES project covers the follow-up research for the Areas 10, 11 and 12 in the Phase B of the Strategic section of the 4th Framework Transport Research Programme (FP IV) of DG TREN. The work was organised into three separately managed Work Areas (WAs), corresponding to Areas 10, 11 and 12.

There were many original objectives of the SCENES project, spanning as it did a wide range of subjects and involving a large consortium of 18 partners. The main objectives and the WAs in which they are located are summarised as follows:

- to develop a databank of variables, covering EU countries and a range of countries in Eastern Europe (WA 10)
- to develop detailed forecasts of factors which will affect transport demand into the future, incorporating institutional factors and studies on breaks in trends. (WA 10)
- to extend to Eastern Europe and enhance with new data a strategic transport model of the EU and to carry out model runs based on the scenarios - this model will be linked to an "appended" logistics module (WA 11)
- to produce transport demand scenarios for the EU for 2020 and beyond. These scenarios are made up of external, socio economic scenarios, and sets of policy scenarios (WAs 11 and 12)
- (existing) regional transport models will also be run to study the impacts of different scenarios (WA 12).

These objectives have been met in the course of the project. The tasks carried out in each of the WAs are now outlined in turn.

WA 10

The SCENES Internet Database has been set up, which contains base year data for 35 European countries and 31 indicators at the regional level as well as socio-economic forecasts generated within SCENES. This database has enabled an information system which focuses on socio-economic and transport demand-influencing indicators for European regions to be established. It has become a unique, easily accessible, data platform for socio-economic data at the regional level. Experience within the SCENES project has shown that from the transport modellers' point of view, there is a definite need for such a reliable, transparent and user-friendly database system to access regional socio-economic data.

Due to unsolved copyright problems the SCENES Internet Database has so far been accessible only for SCENES project partners and the European Commission. However, many of the transport research projects carried out in Europe depend on data from the same set of socio-economic indicators. Therefore, it would be very helpful to have a *common* and *consolidated* data platform for socio-economic data at the regional level. The establishment of such a medium would not only harmonise the input data for the models applied (and therefore the output of the models as well), but might also be useful in terms of saving resources. By providing a common data platform for research projects, repetition of data mining (which is a time-consuming process) could be avoided. From this perspective, the SCENES Internet Database may serve as a first, but decisive step on the way to a pan -European data information system, with regional (socio-economic) data, whose content is not only relevant for transport modellers, but also for policy-makers and other researchers undertaking regional analyses.

The second main area of research within Work Area 10 has embraced the analysis of drivers of transport demand concerning the following topics:

- generation of forecasts for socio-economic indicators for the year 2020 at regional level and for 2040 at national level
- study on interactions between demand and supply in transport
- analysis of impacts of regulatory systems in the transport sphere
- analysis of changes in trends of transport demand
- research on institutional aspects.

Detailed investigation of the drivers of transport demand has shown that the demand for transport is not solely influenced by the factors that are usually included in transport modelling, such as preferences for mobility, sectoral development of production, or transport supply characteristics. In order to explain long term changes in transport patterns it is also necessary to study the demand/supply effects, which occur in second round interactions between *land-use changes and transport development.*

Another area of great influence on the long term development of transport patterns is the type of *regulation* of the different transport sectors. However, in most cases the regulatory changes within public transport have not led to a substantial increase of patronage, but rather to faster rationalisation and more cost efficiency on the supply side. Without direct initiatives towards the harmonisation of transport markets it is unrealistic to expect substantial shifts from individual motorised transport to public transport.

On the contrary, due to the liberalisation process in the road freight and the airline sector in the European Union, further strong impulses have been given towards those sectors, despite all concerns expressed in Green and White Papers on the environmental consequences of such developments. Looking at the railway sector in some detail one can – after studying the performance of different regulation activities in individual Member States – draw the conclusion that these activities had little effect on changing the trends of traffic development. In the case of long distance transport, the reasons for this are that market conditions have not yet been harmonised, and that strong national barriers still exist which hamper the development of international railway operations.

Large external changes, like the transition process taking place in CEE countries, have been able to provoke *changes in trends* in transport demand patterns, whereas other less striking external disturbances have only resulted in a temporary discontinuation of prevailing trends. Thus the analyses of changes in trends suggest the conclusion that: whenever policy-makers intend either to achieve permanent changes from the current trends in transport demand growth, or to achieve decoupling of certain transport demand indicators from economic development, then major and extensive efforts will certainly be required.

The *institutional framework* within which transport markets are embedded has proved of great relevance to the development of transport. The institutional framework provides the guidelines for how externalities are dealt with and for how incentive mechanisms are set. It also tackles the problems associated with transaction costs. Thus institutional aspects determine not only the allocation of costs to certain modes, but also the way transport is organised and operated. Thus it has decisive impacts on reliability, quality, efficiency and security of transport services and thereby on transport demand patterns and the relative competitiveness of modes. Although it is rather complex to demonstrate their effects on transport demand indicators, institutional aspects are an important driving factor of transport demand.

WA 11

The main task in WA 11 was the construction of the SCENES European-wide transport forecasting model. The SCENES model is a network based model of all movements on all transport modes for

both passengers and freight, and it also includes intermodal transport. It uses data and analysis from WA 10, for example, the WA 10 forecasts of socio-economic variables. It has been run to test various policy scenarios for analysis within WA 12.

The SCENES transport model comprises separate passenger and freight demand modules, and a compatible passenger and freight transport model. It is a development of the model created during the preceding STREAMS FP IV project for DG TREN.

The structure of the SCENES model is in essence that of a traditional four-stage model, with distinct Generation – Distribution – Modal Split – Assignment components. However, the costs and times of travel which are output from the transport model feed into the demand model in the form of "disutilities" (derived from zone-pair travel costs and times)– thus the system encompasses a full feedback between the two models. In this way, changes in the transport model, be it through transport cost or infrastructure changes, have a bearing on the demand for travel.

The model is designed to produce in the first instance European level transport forecasts. Comprising as it does of a wide range of demographic, economic, socio-economic and transport factors, and being built as a 'bottom up' model from the zonal level, a much greater level of spatial detail is however possible, and indeed many country and sector specific results are reported in the project. This level of detail can be achieved because the model comprises all transport and travel, including very short distance trips and slow modes.

The 15 European Union countries and eight Central and Eastern Europe Countries (CEEC) comprise the 'internal' modelled area. That is, all travel within this area is modelled. The rest of the world is treated as 'external', i.e., passenger travel and freight traffic to and from these external zones is modelled. The internal modelled area is represented by 244 zones based mainly on the NUTS2 definitions, and the external area is represented by 17 'European' zones with 4 zones representing the rest of the World. The exception is that freight traffic within the CEEC area is not modelled – only freight traffic between the CEEC and the EU, i.e., only the EU15 countries are treated as internal for the freight model.

The ***passenger demand*** model combines highly segmented, zonal level socio-economic and behavioural data to produce a matrix of travel. There are 20 population groups specified in each zone and 10 trip purpose categories. The ***freight demand*** model is based on a spatial adaptation of a financial input-output structure, in order to represent linkages between industries. These inter-linkages are estimated from zonal final demand. Some 24 economic sectors are used in producing a matrix based on value, which is converted to volumes in an interface module. This freight volume matrix can be combined with the passenger travel matrix and assigned to the modal networks in the common transport module.

The ***transport model*** contains a representation of the costs and times of travel by all the different modes (at the country level) between all of the model zones, for passenger and freight traffic. This is achieved using comprehensive and detailed multi-modal transport networks for road, rail, air, shipping, inland waterway and pipeline. An innovative treatment of intra-zonal travel for both passengers and freight allows the characteristics of even the shortest trips to be represented.

The purpose of the WA 11 work was to demonstrate the validity of the model structure, both in terms of the 1995 Base Year results, the 2020 reference case results, and the 2020 transport policy scenarios. These policy scenarios are designed to illustrate the nature of the forecasting process that can be undertaken with the model, rather than form a definitive set of European transport forecasts – in this way they do not constitute any "official" view of the future. In order to achieve the latter, forecasting assumptions and model outputs would have to be developed and analysed in much more detail, in the context of, and in consultation with, existing national level assumptions and forecasts.

WA 12

WA 12 explores specific scenarios and uses a set of modelling tools in order to show how alternative hypotheses might influence the transport system in the future.

It builds on the work realised in WA 10 on the collection of information and on the drivers of transport demand, and on the work in WA 11 on the development of a European-wide model. Based on a set of contrasting scenarios the WA 12 focuses on structural changes and spatial development patterns to explore how these affect the different components of the transport system. In that sense WA 12 provides a complementary approach to that in WA 11.

A variety of scenarios have been built up by exploring a series of different dimensions in separate work streams. Then the results of these have been drawn together in a coherent fashion. Scenarios can be produced to give a number of contrasting images of a future situation through the development of different hypotheses. Two major dimensions of the construction of scenarios have been distinguished in this study

The external (socio-economic) dimension: this comprises the range of external factors (economic, institutional, social, behavioural, technological, geographical) that will influences the future pattern of transport. To a large extent the evolution of these factors is outside the control of the transport policy maker, though they may be influenced by policy decisions outside the field of transport.

The transport policy dimension: this comprises the range of policy initiatives within the field of transport, e.g. pricing, regulation, investment, etc. that the transport policy maker may wish to explore.

Within the external dimension the two main aspects that have been investigated are:

- the **spatial** dimension of Europe and the regional spatial dynamics of an extended Europe. For this dimension two main spatial development scenarios were developed: one which is termed the "Euroland" scenario is a radial development scheme in which the industrialised core of the EU is the centre, the contrasting alternative scenario is a "multi-polar" scheme based on the revival of regional links within an enlarged European space
- the dimension of **structural changes in behaviour:** this includes both the behaviour of passengers through changes in car ownership and attitudes to car use, and the behaviour of companies through changes in their forms of organisation and logistics. For this dimension, two main behavioural scenarios were developed: one is termed the "Unrestricted", the alternative is the "Quality of Life" scenario.

The objectives of these two dimensions are to produce contrasting external scenarios on European spatial development, focusing on regional developments; and to analyse and test the implications of behavioural and structural change for passenger and freight transport in Europe.

In the construction of internally consistent scenarios reference is made to two major trends that are relevant to, but uncertain for the future. These trends provide a common framework for the various scenarios and have impacts on many behavioural changes:

- **Globalisation:** this corresponds broadly to the "Radial Development – Core of EU" spatial scenario and to the "Unrestricted" behavioural scenario
- **Regional integration:** this corresponds broadly to the "Multi-Polar Development" spatial scenario and to the "Quality of Life" behavioural scenario.

The trends are based on contrasting globalisation and liberalisation on the one side with local sustainability and protection of the environment on the other side.

This approach is illustrated through the development of transport policy scenarios concerning two major areas of EU policy: the enlargement of Europe towards CEEC countries, and the Transalpine case study.

- For the enlargement to the East, the policy scenario is a combined infrastructure and pricing scenario for the TINA (Transport Infrastructure Needs Assessment) corridors.

- For the Transalpine corridors, the policy scenario investigates harmonisation of national policies as well as initiatives to achieve an increase in rail modal share in order to reach a 50/50 road/rail balance for Transalpine freight crossings.

For both of these case studies specific transport models have been used: the VACLAV model for the TINA corridors, and the TRANSALP model which has been specifically built within the SCENES project.

The extension of East-West corridors from EU countries and major cities through to Eastern countries have also been chosen as application case studies in order to illustrate the spatial dimension for projections up to 20 or 30 years from now, and to show that a link can be made in the long run between a European vision of the future and concrete localised projects. The two corridors that were studied are

- Paris, Brussels, Berlin, Warsaw, Moscow
- Marseilles, Milan, Venice, Ljubljana, Budapest.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations from the range of tasks within the SCENES fall into three main groups: those concerning drivers of transport demand, those related to transport policy issues that have been derived through the development of scenarios and the use of analytical procedures, and those related to the analytical procedures themselves developed within the project.

Drivers of Transport Demand

The socio-economic forecasts generated within the SCENES project suggest that there are significant differences across Europe. The strongest dynamic of economic growth in Europe is expected to emanate from the accession countries and Eastern European countries, which in the long run will result in a higher level of parity of wealth and cohesion in Europe. A similar contrasting development is forecasted for car ownership growth.

The results of research on demand-supply interaction underline the requirement for an integrated transport policy, which is characterised by a consistent approach to handling the long-term interrelations between transport policy measures and land use, and which also pursues an integrated approach when designing policy measures in order to guide modal split in the required directions.

Other areas of great influence on the long term development of transport demand patterns is the type of regulatory scheme as well as the institutional framework in which transport markets are embedded. In the EU countries, changes in the regulatory systems and changes of organisation in the transport sector have been stimulated, in particular after 1985, in order to improve allocation efficiency and competitiveness. Different concepts for regulating and organising public passenger transport have emerged across Europe. Several case studies have shown that, in certain countries, regulatory change has gone in parallel with growing demand for public transport. This holds true in particular for the introduction of franchising systems rather than outright deregulation. However, in most cases the regulatory changes within public transport have not led to a substantial increase of patronage, but

rather to faster rationalisation and more cost efficiency on the supply side. Regulatory changes in CEE countries have been most effective for the mode road. The types of changes that have occurred related to the road mode can be summarised by demonopolisation (intercity passenger transport by coach operators), decentralisation (urban public transport) and deregulation (freight market). Generally speaking, deregulation in freight transport has been achieved quicker and on a wider basis than regulatory changes in the passenger market.

Analyses have shown that transport demand patterns have been driven by various developments, which are partly internal and partly external to the transport sphere. Both the external developments (e.g. progress of deregulation, institutional framework, changes in demand structures) and the internal developments (e.g. productivity and application of innovative information and communication technologies for transport operation) have acted in favour of the modes road and air but have been stacked against the mode rail. This is problematic since, in the opinion of many policy-makers, rail is the mode that most needs to increase if sustainable transport systems are to be achieved. The studies have shown that only radical changes in circumstances can provoke changes in the prevailing trends in transport demand patterns. Therefore in order to push certain modes, on the one hand comprehensive and integrated policy measures are required, on the other hand a high level of innovation is required on the transport operators' side.

External and Policy Scenarios

The key feature that becomes apparent from the diverse issues that are analysed in the external scenarios is the need for *flexibility* in the transport policies that may be developed. There are major political and social forces (particularly in the countries outside but bordering on the EU) that could radically alter the future travel demand pattern. Accordingly, transport policies should be such that, if and when major breaks in trend occur, the policy can be adjusted so as to still retain its original coherence.

Yes it is important to use good analytical tools to forecast the potential impacts of transport policy measures. However, it is also important that these policy measures do not rely unduly for their success on an ability to accurately forecast future external social and political events across Europe. Policy measures need to be robust to a range of possible future external scenarios.

The other main finding from the analysis of external scenarios is the importance of behavioural and structural change factors for households and firms in determining future transport patterns. Strategic transport studies need to look at a wide range of behavioural and attitudinal issues from outside the transport system that may have a major future impact on transport itself.

The main policy conclusions are drawn from the two transport policy scenario case studies that have been carried out.

The combined infrastructure and pricing scenario applied to the TINA corridors

The combined infrastructure and pricing scenario has shown that most parts of the road and rail infrastructure of the TINA core networks could be financed by charges on the users. However, when comparing the share of rail infrastructure assumed not to be built with the share of road infrastructure assumed not to be built, the approach that was applied of internalising the infrastructure costs, results in a higher share of rail infrastructure being shown to not be financially viable, than is the case for road infrastructure.

Summarising these results leads to the conclusion that the assumptions made in this policy scenario are ill-adapted to encourage the sustainable development of transport. Quite contrary to the goal of achieving more sustainability in transport, the assumptions of infrastructure building in this policy

scenario encourage higher market shares for the modes: private car and air but a decline in the rail share.

The second important finding from this study is that is has proved more difficult for the rail mode to finance its infrastructure from its users than is the case for the road mode. This is due to rail's higher infrastructure building costs and relatively high maintenance costs.

Policy scenarios for Transalpine freight

The clearest outcome of this study is that a new, supra-national, authority should be created, with the mission of co-ordinating global Transalpine issues linked with transport and the environment. This authority should lead to a better harmonisation of policy measures, infrastructure planning, realisation and operation amongst the Alpine countries as well as amongst countries influencing Transalpine transport. The main Transalpine freight issues this new authority should tackle are listed below.

Two interrelated measures would be needed to achieve a proportion of rail freight equal to that on road: first, all new Transalpine rail investment projects linking France, Switzerland and Austria to Italy are needed, not merely for the extra capacity, but also to enable high commercial rail speeds to be achieved; secondly, their realisation should be synchronised with the complete removal of institutional obstacles.

Analysis of the Transalpine relations in the database shows that countries far away from the Alps, primarily on the North-South corridor, are important traffic generators. Indeed, Alpine crossings regulate modal choice far upstream, and also the upstream modal choice influences the selection of the crossing point. Accordingly, the main origin and destination regions should participate – to some extent - to modal shift measures and/or to finance infrastructure. A legal structure has to be developed to enable this to occur.

Consequently, at the larger scale, national policies have to be harmonised with the objective of influencing traffic flows all along the international logistics chain: road freight should not be heavily charged in the locality of the Alpine regions, while at low cost on the rest of the continent.

New large-scale projects aimed at achieving globally more efficient and sustainable Transalpine transport should be financed trans-modally, seeking modal solidarity, over one or two generations, whereas the traditional (unimodal) long-term return on investment approach should be left to the case of local infrastructures, where modal choice is less appropriate. An official framework should be produced, with a clear definition of the objectives, in terms of sustainability, transport efficiency and finance.

Methodological developments

Perhaps the most important methodological outcome is the demonstration that a comprehensive transport model for Europe can be created, which validates well at the national level. Many innovative research features have been developed in the creation of this model.

The usefulness of this SCENES European model has been illustrated through:

- running the model to produce a reference case for 2020 that can provide a baseline set of future transport results across Europe for use as input to other studies
- testing a range of policy scenarios for 2020 on the future evolution of transport costs by mode, both for passengers and freight.

The main aspects in which this model would benefit from future improvements are:

- modifying the assignment procedure to adopt differential sampling of zone pairs in order to increase the level of spatial detail, especially on the road network

- provided that improved coverage and harmonisation of passenger and freight data across the EU can be achieved, the quality of the local calibration in the SCENES model could be improved through the use of this improved data.

This SCENES model is at its strongest when operating to represent strategic issues at the European-wide level, but currently is less suited to analyse specific small-scale initiatives in a particular locality.

In this study the SCENES model focused on policy testing within a single external scenario. In the future, other alternative external scenarios could be developed based on different assumptions regarding the evolution, for example, of GDP and car ownership growth and of the sectoral patterns of future trade. Likewise, a wide range of other transport policy scenarios (e.g. major infrastructure investment, regulation of road vehicle speeds, fuel taxation, etc., applied differentially to some or all regions or parts of the modal networks) could be tested across Europe using this model.

Another important topic in which the SCENES model could be of future value is through use of its comprehensive reporting capability to provide a future transport baseline as a foundation for European transport projections. The potential role of European transport projections is as an agreed background input to studies in related topics, such as energy usage, pollution emissions, accessibility and social exclusion. In the absence of agreed European transport projections such studies are forced currently to make their own projections (often of poor quality), with the resulting disadvantage that they rarely will be common across studies.

It is however clear that a single pan-European model is not sufficient to meet all policy testing and scenario development needs. Accordingly, a range of well-known models from different European countries has been put together within a common framework of analysis to explore behavioural and structural change issues. Each model highlights different specific aspects of the transport system. Through taking this partial modelling approach, in which only a particular corridor or a sub-set of travel movements is analysed in detail, it is possible to analyse the specific topics of interest in greater depth.

However, considerable care needs to be taken with models designed for a specific locality or purpose, when extending their results to provide more general insights across Europe. The ever-present danger when adopting and combining results from an array of different models is that their underlying assumptions and data definitions may differ significantly between the models.

This highlights the need for clear specifications of agreed baseline assumptions when defining scenarios. There is an important role to be played by DG TREN in the future in the development of an agreed baseline set of transport projections and assumptions for use both for studies within DG TREN and elsewhere.