EVA-TREN

IMPROVED DECISION-AID METHODS AND TOOLS TO SUPPORT EVALUATION OF INVESTMENT FOR TRANSPORT AND ENERGY NETWORKS IN EUROPE

SIXTH FRAMEWORK PROGRAMME
PRIORITY 8.1 Policy-oriented research

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0 Introduction

Large infrastructure projects are typically the results of rather lengthy processes that involve various administrative levels, as well as political institutions, consultants, contractors in the private sectors, and different stakeholders. As a result, the decision process takes place during a period of time which is, for most of the projects, a “very long” one. Objectives might change during this period, and the time dimension of the decision process must be integrated and managed because it might distort the evaluation results and the information associated to each step of the process. This decision making process clearly involves different steps, from prior general investigations to the definitive evaluation, including design of the infrastructure. The traditional project appraisal approach proceeds from very general to very specific assessment: for instance, the local environmental assessment is likely to be detailed in last stages only, when local impact can be known with precision. The major inconvenience of this approach is that at the first stages of the process, the environmental aspect is very general and that at the later stages the economical assessment is not sufficiently reviewed. The result is that the project that has been appraised is not the one that is going to be realised and, what is more important, the appraisal has not been used to select the best layout.

An appraisal approach that aims to really support the decision making process must adapt to the different stages with more detailed analysis when the project has been defined. This implies a continuous monitoring of project impacts and success with learning form past experiences and asks for the need to consider the whole decision process including project monitoring and ex-post evaluation as a continuous process with different stages. In this comprehensive approach, the ex-post evaluation should enable the ex-ante evaluation procedure to be fine-tuned through an ongoing feedback process between the operating results of existing infrastructures and the assumptions used to evaluate new capital expenditure decisions.

The EVA-TREN research project, supported by the European Commission and developed within the VI Framework Programme, aims at improving the ex-ante appraisal practices for the assessment of large energy and transport infrastructure projects through the ex-post analysis of several case studies.

The question to which the EVA-TREN project is expected to answer regards the effectiveness of the current assessment tools and practices in dealing with complexity of problems addressed. As a matter of fact, evaluation tools should be planning instruments useful to establish a dialogue with the other projects phases and, at the same time, to manage the several dimensions involved in the policy decision support. The approach followed by the project could be summed up as follows:

1. identification of the most critical aspects concerning the implementation of large infrastructure projects;
2. supporting the developments of tools, indicators and operational parameters for the assessment of sustainable transport and energy network;

3. suggesting good practices to the policy makers.

This final report provides an overview of the EVA-TREN project approach and results, following a refinement process which started from the detailed analysis of 11 European case studies to end up in providing recommendations for the improvement of the methodology for ex-ante and ex-post evaluation of large infrastructure projects in the energy and transport sectors. The case studies provided inputs for a specific analysis of ‘problems’ in the implementation of the case study projects that could have been avoided had the project been appraised ex ante using different approaches/methods. This analysis will allow drawing recommendations for enhancing project assessment in the transport and energy TEN programmes.

The conclusions drawn from the first case studies analysis, completed following a strong common structure, were the basis for the identification and discussion of a set of preliminary solutions that were inputs for case studies re-examination in order to verify their effectiveness in increasing the capability of the projects in achieving their identified goals. The most effective ones were then presented and discussed with experts and stakeholders in a two days workshop on November 2008.

0.1 The structure of the document

The structure of the documents follows directly the various steps of the work completed within the project. Chapter 1 presents a brief overview of the state of the art in project evaluation as it comes out from the review the theoretical basis of currently applied methodologies in the energy and transport sector, carried out in WP1, with the contribution of the first EVA-TREN workshop.

Chapter two summarise the main evidence from the ex post examination of the eleven transport and energy case studies – completed in WP2. Chapter three outlines the preliminary solutions proposed aiming at strengthening the evaluation of investment in transport and energy networks and the results of their re-examination through the case studies. The final recommended improvement in the ex ante and ex post assessment of large infrastructure project in the energy and transport trans European networks are presented in chapter four.
1 Evaluating the State-of-the-Art in Investment for Transport and Energy Networks

The primary objective of WP1 is to evaluate the state-of-the-art of current assessment methodologies for infrastructure investment projects. An overview on the theoretical basis of project assessment is given in order to provide a review of approaches currently applied in the European Union and in the rest of the World. The evaluation is carried out for the Energy and the Transport sector. Four main tasks have been carried out, which are:

- Review on national methodologies (ex-ante versus ex-post project assessment),
- Review of research projects on assessment methodologies (update of the state-of-the-art in assessment research for infrastructure projects),
- Modelling implications (future challenges in modelling),
- Conclusions (identification of key issues in current project assessment).

The outcome of WP1 provides background information for the following Workpackages especially for the analysis of the case studies (WP2). For that reason all countries where a case study is located have been chosen for analysis (see Figure 0.1). Furthermore, an international overview of selected countries and of supranational organisations with comprehensive approaches is given. Especially differences between both sectors have been elaborated on a theoretical as well as practical basis.

Theoretical approaches for transport infrastructure assessment are manifold. Cost-Benefit-Analysis\(^1\) (CBA) and Multi-Criteria-Analysis (MCA) are most common and well established within the scientific community. The theoretical basis of CBA lays in the assumption that benefits increase whereas costs reduce well-being of society. Following this approach, an investment is worthwhile if its benefits exceed its investment costs. Contrary to this approach MCA uses the way of thinking of decision makers, represented by pre-defined criteria and weights. Different from CBA, that represents the single welfare maximisation criterion, MCA is an approach for multiple criteria rationalisation. Another way of thinking in assessment methodology are macroeconomic approaches, like Input/Output and simulation models (e.g. System Dynamics). Their main objective is to forecast regional and national impacts (e.g. GDP, income) induced by the infrastructure investment.

Assessment approaches for energy infrastructure investments differ significantly from transport investments. Main theoretical approaches are load flow based investigation and locational marginal pricing. Load flow based investigation can be used to analyse network density on the

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\(^1\) The abbreviation CBA has only been used in the following chapters for socio-economic Cost-Benefit-Analyses. If financial CBA is meant it is specified directly in the text.
The approach evaluates the maximum capacity of the network in case that one line fails to operate. Locational marginal pricing is a market-pricing methodology for energy sector projects. It is aimed at assigning a price to electricity at specific locations on the transmission grid. Differences in prices between nodes reflect the costs of transmission and can be used as an indicator for future investments.

The findings of existing practice of project assessment in the Energy and Transport sector has emphasised a number of similarities but also differences across the countries under consideration. It can be assumed that national guidelines have been developed over a long time span and that differences nowadays results from different development pathways. The authors ascertain that for the transport sector even within Europe no single national methodology is equal to another. Data shows that most countries use Cost-Benefit-Analysis in some form for decision making. In the analysed New Member States CBA has been used most commonly for projects funded by the EU. Based on these EU guidelines national guidelines have been developed (e.g. Czech Republic). The majority of countries in the North/West of Europe (e.g. Germany, United Kingdom) have detailed guidelines for project assessment, whereas most countries in the Southern parts of Europe have only few national standards for assessment (e.g. Portugal, Italy). Decisions are mostly based on case-to-case comparisons with a changing assessment framework.

Concerning the general methodology for transport project assessment, Switzerland and the United Kingdom show significant differences to the other analysed countries. In Switzerland an environmental impact analysis for every infrastructure investment is compulsory. Further assessments such as CBA or MCA are not required by law. The United Kingdom has changed its assessment methodology during the last decade principally. The New Approach to Appraisal (NATA) bases on Multi-Criteria Analysis and its results are summarised in an Appraisal Summary Table, which includes mainly quantified parameters instead of monetizing the impacts. A contrary approach to most other countries where decision making is based on the Cost-Benefit-Ratio or the Net-present value.
The analysis of Workpackage 1 shows that there are differences between the surveyed countries concerning their fundamental input parameters. Two of these parameters are the Discount Rate and the Appraisal Period, which are illustrated in Figure 1.1 and Figure 1.2.

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2  The figure is based on results of Workpackage 1 supplemented by data coming from Odgaard et al., 2005
Figure 1. 2 Discount rate (real terms) used for transport infrastructure investments

Figure 1.1 shows that significant differences in the discount rate are used in the analysed countries. It is not possible to derive any general conclusions neither for geographical classification nor for average values from the figure above. Especially for projects where benefits occur during the following decades the discount rate plays a crucial role. The former EU project UNITE recommended a real discount rate of 3% as standard value. It can be noticed that most countries use higher rates. More important than the discount rate itself is the correlation to the appraisal period as well as to the residual value of the project.

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3 The figure is based on results of Workpackage 1 supplemented by data coming from Odgaard et al., 2005
In the North of Europe a longer time period is assessed than in the analysed New Member States of the EU. Also the South European countries use in average a shorter appraisal period than the Northern parts. For a fourth of the analysed countries significant changes in the appraisal period exist for different modes of transport. Therefore, the authors have abdicated of illustrating averages value for these countries (green colour).

Figure 1.2 shows that there is no correlation between the appraisal period and the integration of a residual value for investment projects. More than half of the assessed countries include the residual value whereas none of the new member states do so.

EVA-TREN also evaluated national guidelines for ex-post analyses of infrastructure investments. In only two out of twelve countries an appraisal to verifying the results of the investment is compulsory (France and United Kingdom). France has defined the principle of ex-post analysis within the LOTI (Loi d’Orientation sur les transports intérieurs) in 1982. The general guideline includes a physical description of the project as well as a direct comparison between expectations and observed figures (e.g. costs, demand, environmental impacts). Nevertheless, it is not enforced for each project so far.

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4 The figure is based on results of Workpackage 1 supplemented by data coming from Odgaard et al., 2005
In a few countries (e.g. Denmark) ex-post evaluations are carried out at times but neither national guidelines nor official recommendations exist. However, most countries do not analyse the impacts of the transport infrastructure investment comprehensively on a national level (e.g. Germany). In some cases regional or local authorities verify the (mostly positive) impacts for publicity reasons. This procedure is contrary to recommendations and proceedings of different international authorities. Even though ex-post analyses are not standardised, they are at least common in order to verify the extents and the effectiveness of their funding. An abridgement of applied approaches is summarised in the following table.

Table 1.1 Approaches for ex-post assessment suggested from different authorities

<table>
<thead>
<tr>
<th></th>
<th>Monitoring</th>
<th>Assess the impacts</th>
<th>Re-appraisal w. updated figures/new impacts</th>
<th>Independent re-appraisal.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DG TREN</strong></td>
<td>Assessment by interviews of relevant results (efficiency, accessibility, etc.). (COWI, 2006a). Independent appraisal of actions, but no guidelines (DG TREN, 2003)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>World Bank</strong></td>
<td>Monitoring and formative functions</td>
<td>Systematic repetition of past CBAs with updated inputs only.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>UNIDO</strong></td>
<td>Monitoring and formative functions</td>
<td>Consider new impacts and compare ex-post the evidence of the inclusion.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OECD</strong></td>
<td></td>
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</table>

Furthermore, cases of re-appraisals of transport and energy projects are present in literature, which has been carried out by academics, professionals or by the financing agencies. A comprehensive analysis of transport infrastructure projects can be found in Flyvbjerg et al (2003). It is pointed out that in average costs are underestimated and demand, revenue and
economic impacts are overestimated. An observation that strongly supports the idea of learning from realised transport infrastructure projects (ex-post experiences).

The results of the Energy sector show a different picture than for transport investments. EVA-TREN has been focused on evaluating transmission grid investments because all Energy case-studies of Workpackage 2 deal with transmission grid investments. Furthermore, the Energy sector is very heterogeneous concerning infrastructure investments (e.g. power plants, transmission grids, renewable energy sources) that a focus has to be placed on one subsystem.

The first impression when comparing both sectors is that transport investments are mostly financed by public bodies whereas most transmission grid companies are in private hands (see Figure 1.3).

Figure 1. 4 Ownership of the transmission grid companies

The above figure shows that only five national transmission grid companies are in public hands. In these countries companies exist which are responsible for transmission but they are completely in the scope of the public body. In Denmark, for example, Energinet.dk is the state-owned transmission system operator which owns the national electricity transmission systems. Investments in the national grids are financed by Energinet.dk and the Ministry for Transport and Energy has to agree on the planned investments. In Hungary the transmission grid company
(MAVIR) has been set up for liberalising the electricity trade. MAVIR took over the functions and assets of the former power generation and grid company (MVM). The owner of MAVIR is the Hungarian State, the ownership rights are exercised by the Ministry of Economy and Transport. Revenues coming from transmission fees have to cover only the operational costs of the company whereas investments are financed by the owner of MAVIR, the Hungarian State.

The majority of assessed countries do have private transmission grid companies. A private company has been defined in this context that shares of the company are traded, can be purchased directly and are on the majority in private hands. In Spain, as an example for this sample, transmission grids are owned by REE (Red Eléctrica de España). Shareholders are private companies of the Energy sector (~10%), the government via the State Industrial Ownership Cooperation (~20%) and free floats (~70%). Other countries have similar structures with (minor) shares in public hands (e.g. Germany).

Concerning the methodology used for assessing infrastructure investments differences between the transport and energy sector occurred. Most transmission grid companies use the (n-1) security criterion for security of supply investigations as well as for future investment planning (see Figure 1.4).

Figure 1.5 Methodology for assessing transmission grid investments
These results are in-line with recommendations of the Union for the Co-ordination of Transmission of Electricity (UCTE). They recommend using the security criterion for daily supply analyses whereas EVA-TREN found out that the criterion is also exercised for long-term investment planning.

Ex-post analyses for transmission grid infrastructure investments are not compulsory by law in any country. No differences have been found for private as well as for public owned companies. However, several companies (e.g. Danish Energinet.dk) have stated that audits are carried out to learn from past experiences. Guidelines are not published and results are only used internally. Comparing to the transport sector the ex-post evaluation process in the Energy sector seems to be further developed and more frequently undertaken even though they are not open for the public.

Comparing the national findings in Europe with international countries and bodies the results are similar. In Canada general guidelines for investments exist from the Canadian Treasury Board, which have been modified by the Department of Transport and are applied for every transport infrastructure project. Differences between the EU and Canada exist in the value of the discount rate. In Canada a real discount rate of 10% is applied which is much higher than the European average (around 5%) or the recommendation of the European Commission (3%). The US Department of Transportation provides a single guidebook for CBA of transport infrastructure projects. Net present value, internal rate of return as well as benefit-cost ratio are compulsory for decision making. A discount rate of 7% is recommended by the department. Japan uses a mixture of CBA and MCA for infrastructure assessment. Thereby, CBA serves to judge which project should be chosen among the available options and MCA is used for project ranking. The key indicator for project selection is the benefit-cost-ratio. Appraisal period is assumed to be 40 years, while the discount rate is fixed at 4%. Investments with a benefit-cost-ratio of higher than 1.2 are admitted in the list of feasible options. These options are further assessed especially concerning intangible impacts.

In none of these three countries (Canada, US, Japan) ex-post analyses for transport investments are compulsory. No specific guidelines exist on how to undertake the evaluation process. However, in all of the three countries a growing demand for measuring results after construction has been found out by the authors.

Regarding the Energy sectors in Canada, the United States and Japan, no specific guidelines for ex-ante nor for ex-post analysis exist.

The World Bank evaluates investment projects in every sector before (ex-ante) and after (ex-post) implementation. The same approach is applied for each sector. Every project undergoes the general methodological approach which is strongly based on CBA. Generally, no projects are accepted with an internal rate of return less than 10%.

The Directorate General (DG) Transport and Energy of the European Union has not defined specific procedures for project appraisal because transport as well as energy projects are mainly funded by resources of other DGs. DG REGIO, for example, is able to support transport as well
as energy infrastructure projects to achieve its objectives of regional development. Submissions to DG REGIO should contain results of a feasibility study, a timetable for project implementation, CBA, an environmental impact analysis, a justification for the public contribution and a financial plan showing total planned resources. Based on these information decision for financial support is made.

Art. 49 of Reg. 1083/2006 states that ex-post evaluations of all programmes, which have been implemented under each objective should be carried out. It is aimed at identifying the factors contributing to the success or failure of programme's implementation and at identifying good practices. Nevertheless, DG REGIO does not provide any guidance on how to carry out ex-post evaluation.

In general it can be concluded that both networks uses different assessment approaches. The transport sector is mainly focused on CBA whereas the Energy sector uses security or pricing criterions for decision making. Tab 5.6 aims at comparing these two industries. It reveals that in the energy sector a number of aspects, which are highly relevant for transport project assessment, are not relevant for energy infrastructure. Examples are socio-economic impacts or user effects.

On the other hand relevant energy issues, such as the security of supply, are not that dominant for transport networks. There are some aspects, e.g. the modelling of congested or dropped out lines, which are modelled much more accurately in the energy sector than in transport, as the consequences of shortages in supply in the two industries are different.

Table 1.2 CBA Aspects and their treatment in energy and transport investment planning

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Transport Networks</th>
<th>Energy Transmission Networks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimation and quantification of external</td>
<td>Air and GHG emissions of mobile and stationary sources, noise: generation and</td>
<td>Air and GHG emission and dispersion models for power stations; not relevant for transmission</td>
</tr>
<tr>
<td>effects</td>
<td>dispersion models; accident models, etc.</td>
<td>networks.</td>
</tr>
<tr>
<td>Elasticity of supply with quality of network</td>
<td>Induced traffic: assessment standard</td>
<td>Only relevant for areas with weak energy supply networks; less relevant for (western) Europe</td>
</tr>
<tr>
<td>supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact of new or dropped network links</td>
<td>Road: Detailed prediction with difficulties; rail and air: standard simulation</td>
<td>Very sophisticated modelling; daily network simulations with n-1 rule</td>
</tr>
<tr>
<td></td>
<td>models by service and/ or network operators.</td>
<td></td>
</tr>
<tr>
<td>Prediction of spatial and time-related</td>
<td>Most relevant in long term (15-30 years). Spatial structure most relevant</td>
<td>Rather relevant in medium term; availability of sophisticated models</td>
</tr>
<tr>
<td>demand structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-economic impacts of investments</td>
<td>Feedback requires dynamic assessment: Macro-economic models (CGE, system dynamics,</td>
<td>Relevant driven by price differentials, security of supply</td>
</tr>
<tr>
<td></td>
<td>econometrics, mcpf, elasticities, etc.)</td>
<td></td>
</tr>
</tbody>
</table>
Looking for improvements of the existing approaches various controversies are discussed within the scientific community. Some open issues have been stated in WP1 which have been further analysed in the coming Workpackages:

- risks and uncertainties: A very crucial point for every project assessment is how to deal with future scenarios. Assumptions on costs, benefits and impacts have to be made before they are realized. This means introducing uncertainties and risks and dealing with them;

- marginal opportunity costs of public funds: If a state uses money of public funds to finance an investment project it causes a loss in collective richness, due to alternative use of that money;

- equity and distributive issues: Most conventional approaches produce a single indicator as their output (CBA uses NPV or B/C-ratio). These indicators are aggregate measures, supposing that benefits (and costs) will be redistributed to all individuals of society. It does not state who will profit and who will loose;

- option value theory: Option values are based on the consideration that for those projects, which have a long-term time horizon and imply a large investment in a quite uncertain context, the gain and loss opportunity should be taken into account instead of including the values only.
of models in general and gives some theoretical recommendations for the future. The following modelling implications have been discussed in detail:

- **current CBA methods**: Core elements of traditional CBA are for transport infrastructure the development of user times and operating costs. Therefore, different future scenarios for transport demand are used. This leads to the classical four stage procedure of transport modelling with its existing uncertainties;

- **complexity of networks**: Transport plans mostly disregard inter-relationships between different investments. These mutual inter-relations might be positive in the case of supplementary projects, but might also be negative in case of competing investments;

- **dynamics of Systems**: System dynamics model, such as ASTRA, have been introduced to study dynamic development and feedbacks between sectors of the economy and the society. The various cost and benefit categories analysed in CBA develop over time which is not considered in static tools;

- **dynamics and spatial complexity**: Macroeconomic models do not suffice to simulate local impacts and related small-scale policies. To overcome this gap the EC has launched the TRANS TOOLS project. The model shall enable to analyse new infrastructure investments and fiscal instruments. Among others, the TRANS-TOOLS model shall overcome a number of shortcomings of prior European models, such as limited geographical detail, weak consideration of intermodal logistics chains or missing links to the economic sector;

- **technical progress and innovation**: Technical progress might be triggered by policy decisions. In most cases technological progress and innovation happens outside the sector under consideration. Existing models do not answer this question as they consider technical progress as an exogenous variable;

- **new approach for assessment**: Differences between forecasts and reality have been observed for many projects during the last decades. Therefore, the concept of “Reference Class Forecasting” has been developed. It relies rather on the outcomes of similar projects than on a single CBA.

The results of WP1 show that complex models and methodologies for assessment infrastructure investments exist. Recommendations of WP1 have been analysed in detail in the following Workpackages of EVA-TREN. These general recommendations deal with:

- develop linkages between existing models;

- the compulsory application of ex post analysis;

- technical improvements: Introducing marginal opportunity cost of public funds, means filling the gap between financial and economic analysis which is missing in existing models;

- basic recommendations: Assessment independent from decision making, transparent evaluation tools, analysing alternatives (technical as well as modal alternatives), reference to similar projects.
2. Case studies of ex post analysis

Following the results of the first work package, which provided the theoretical basis of currently applied methodologies in the energy and transport sector, in the second work package eleven projects in the transport and energy fields have been analysed (Table 2.1). The objective is the ex post reassessment of the selected projects in order to deliver a critical review of common mistakes and pitfalls and a set of recommendations on how to improve the methodological quality of the projects ex ante appraisal.

Table 2.1 Selected case studies

<table>
<thead>
<tr>
<th>Project</th>
<th>Country</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterway Cross Magdeburg</td>
<td>Germany</td>
<td>The Waterway Crossing Magdeburg is part of the German midland canal which crosses the centre of Germany from West to East, namely from the Ruhr area to Berlin. It is owned and managed by the Federal German Waterway and Navy Agency.</td>
</tr>
<tr>
<td>Oeresund Fixed Link</td>
<td>Denmark - Sweden</td>
<td>The fixed link connecting Denmark to Sweden (Copenhagen and Malmo). It is currently owned and operated by the Oeresundsbro Konsortiet, which is 50% in the hands of the Swedish state and 50% in those of the Danish state.</td>
</tr>
<tr>
<td>ICE Frankfurt-Cologne</td>
<td>Germany</td>
<td>An HST railway linking Cologne to Frankfurt. It is part of the 1,200 km long high-speed railway axis Paris-Brussels-Cologne/Frankfurt-Amsterdam-London (PBKAL), one of the fourteen projects of the trans-European transport networks (TEN-T) which the European Commission endorsed in 1994. It is operated by the Deutsche Bahn Mobility AG, which is the national railway operator, and the owner of the line is the Deutsche Bahn Netz AG (German Railway Network Inc.).</td>
</tr>
<tr>
<td>Paris-Lille TGV</td>
<td>France</td>
<td>The extension toward the South along the Rhone Valley of the French HST network. It is part of the 1,200 km long high-speed railway axis Paris-Brussels-Cologne/Frankfurt-Amsterdam-London (PBKAL), one of the fourteen projects of the trans-European transport networks (TEN-T) which the European Commission endorsed in 1994.</td>
</tr>
<tr>
<td>Lyon-Marseille TGV</td>
<td>France</td>
<td>The extension toward the South along the Rhone Valley of the French HST network.</td>
</tr>
<tr>
<td>Madrid-Seville AVE</td>
<td>Spain</td>
<td>The High Speed Line connecting Madrid to Seville. The national train operator RENFE operates the train while the administration of the infrastructure is in the hands of the ADIF, a state-owned company.</td>
</tr>
<tr>
<td>Eurotunnel</td>
<td>United Kingdom - France</td>
<td>The Channel Tunnel between France and England, connecting Folkestone, Kent (UK) with the terminal of Coquelles (France). It is the second-longest rail tunnel in the world, the Seikan Tunnel in Japan being longer, but the undersea section of the Channel Tunnel, at 37.9 km, is the longest undersea tunnel in the world.</td>
</tr>
</tbody>
</table>
**Project** | **Country** | **Description**
--- | --- | ---
Baltic Sea Motorway | Germany | The German Federal Motorway A20 between Stettin (Polish border) and Lübeck (State of Schleswig-Holstein in west Germany). Operative management and maintenance are carried out by the federal state of Mecklenburg-Western Pomerania through the state-funded motorway service companies. High maintenance: the federal government directly carries out reinvestment and rehabilitation programmes. The private Toll Collect consortium in co-operation carries out toll collection and conduction with the Office for Freight Transport (BAG). This private motorway model holds for the vast majority of German motorways.

Malpensa 2000 | Italy | The Malpensa airport has become the main airport of Milan metropolitan area (1.3 million inhabitants in the city, more than 3 million in the hinterland), but serves as the international and intercontinental airport for the whole of northern Italy. It was also intended to become one of the two “hubs” of the Alitalia company, oriented to the Mediterranean, the Balkans, Eastern Europe, Africa and the Americas.

Iberian electricity network interconnection | Spain - Portugal | The Alqueva-Balboa and Cartelle-Lindoso, the two physical works inside the IBELM framework included in this study, are part of the European Union TEN Energy network. The construction of the first line is partially financed by the TEN-energy framework, while the Cartelle-Lindoso is financed by the ERDF (European Regional Development Fund) and TEN programme. It entered into service at the end of March 2004, instead of 2006 as previously scheduled by the Protocol. Its cost is 7M Euros.

The CH-IT electricity cross-border connection | Italy - Switzerland | Part of the 1997 trans-European energy network programme [EU 1997]. Since 2004 it has been included within the TEN-E priority project list. On the Italian side, it was included in the Three-Year Grid Development Plan for the period 2002-2004, submitted by the GRTN for the approval of the Ministry of Productive Activities. The programme agreements (“Accordo di Programma”) were signed in 2003 in order to finalise the construction of the power line. In February 2004, the Italian decree No 109 permitted the realisation of the line. On the Swiss side, the authorisation procedure was realised by the Swiss Federal Inspectorate for Heavy Current Installations (ESTI, Eidgenossisches Starkstrominspektorat), which gave its final authorisation in August 1993.

The methodology used for the case study analysis comprised two common templates (one for the transport and one for the energy) for data collection as well as methodological guidelines for data processing. These allowed the identification of the full list of relevant quantitative and qualitative data to be collected in fieldwork and aimed at ensuring comparability and relevance of data collection by providing a standard grid for data processing. The data collected and processed have been the starting-point for discussion about the effectiveness of tools and techniques for project appraisal, according to the main differences between the ex ante and the ex post analysis.
Case studies analysis has been structured in order to allow a horizontal reading of the sample of projects alongside a number of topics:

- Project objective
- Decision-making process
- Context analysis
- Options analysis
- Demand analysis
- Financial analysis
- Economic analysis
- Environmental analysis
- Analysis of uncertainties
- Regional economical impact assessment

A full comparison has not always been possible, however, owing to the considerable conceptual differences existing between the transport and energy fields and the heterogeneous availability of information and data for all the cases. Financial and economic data are the areas in which major difficulties in availability have been encountered, especially for the two energy projects.

Every effort has been made, therefore, to rearrange the existing evidence in order to identify key issues at stake for every project as well as for every kind of analysis considered.
Table 2.2  Availability of analyses by case (X=available; O=Not available)

<table>
<thead>
<tr>
<th>Options</th>
<th>Demand analysis</th>
<th>Financial analysis</th>
<th>Economic analysis</th>
<th>Environmental analysis</th>
<th>Uncertainties analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ex ante</td>
<td>Actual</td>
<td>Ex ante</td>
<td>Ex post</td>
<td>Ex ante</td>
</tr>
<tr>
<td>Waterway Cross Magdeburg</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Oeresund Fixed Link</td>
<td>O</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ICE Frankfurt - Cologne</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Paris - Lille TGV</td>
<td>O</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lyon - Marseilles TGV</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Madrid - Seville AVE</td>
<td>O</td>
<td>O*</td>
<td>X</td>
<td>O*</td>
<td>X</td>
</tr>
<tr>
<td>Eurotunnel</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Baltic Sea Motorway**</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>O</td>
<td>O*</td>
</tr>
<tr>
<td>Malpensa 2000***</td>
<td>O</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Iberian electricity network interconnection</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>O*</td>
<td>O*</td>
</tr>
<tr>
<td>The CH-IT electricity cross border connection</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>O*</td>
<td>O*</td>
</tr>
</tbody>
</table>

Source:  Our data processing

Legend:  X: Available; O: Not available; # For energy projects this should be intended as the Security “N-1 criterion” analysis; * Existing, but not available because confidential; **In Germany, Economic Analysis is Mandatory however the Baltic Sea Motorway like all 17 priority projects of German Unity, were not subject to the full analysis methodology of the Federal Transport Investment Plan. No monetisation of costs and benefits is available; ***Economic analysis carried out not through CBA but through regional economic impact assessment.

2.1  Project objectives

Throughout the sample it becomes clear that single projects have different objectives and different stakeholders (see Table 2.3).

Roughly speaking, each project showed to have at least three different objectives as well as three stakeholders belonging to different government levels. Projects in the sample in fact have contemporarily a supranational, a national and a local dimension and each of them correspond to different stakeholders.
Table 2.3 Main objectives of the projects in the sample

<table>
<thead>
<tr>
<th>Project</th>
<th>Local objective</th>
<th>National objective</th>
<th>European objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magdeburg Waterway Cross</td>
<td>To overcome the risks of crossing the Elbe in order to continue on the canal route toward Berlin and to foster economic development in an underperforming region.</td>
<td>To cover a missing link in the Micland canal network in Germany.</td>
<td>To create further capacities on the West-East axis.</td>
</tr>
<tr>
<td>Oeresund Fixed Link</td>
<td>To foster economic development at regional level as well as pushing the creation of shared labour and housing markets in the Oeresund region with benefit to both countries.</td>
<td>To connect two countries, thereby producing the conditions for strengthened and enlarged cultural and economic collaboration.</td>
<td>The fixed link transforms road and rail travel between Sweden and Denmark, allowing the Copenhagen and Skane regions to develop as a single cross-border region. In addition together with the Great Belt, the link would have constituted the basis for the North South transport axis.</td>
</tr>
<tr>
<td>ICE Frankfurt - Cologne</td>
<td>To develop a shared labour and working markets in the area between Frankfurt and Cologne and to foster demand on the residential market and commercial properties in the cities alongside the line.</td>
<td>To complete the national high speed network and to connect two regions which play a crucial role for the German economy.</td>
<td>To create an HST network which could connect Paris, Brussels, Cologne/Frankfurt, Amsterdam and London.</td>
</tr>
<tr>
<td>Paris - Lille HAST</td>
<td>Development of the region concerned by the project (Nord Pas de Calais) including industrial activity and tourism.</td>
<td>To create frequent high-speed services on the line from Paris and Lille, inducing also changes in traveller behaviour in the perspective of the A1 motorway congestion.</td>
<td>To create an HST network which could connect Paris, Brussels, Cologne/Frankfurt, Amsterdam and London*.</td>
</tr>
<tr>
<td>Lyon - Marseilles HST</td>
<td>Regional development and in particular implementation of new stations: Avignon, Aix. Development of the area of the stations Improve accessibility of regional metropole to Paris.</td>
<td>To complete the HST network in France allowing an interconnection also to Spain with a line which would have passed by Paris.</td>
<td>Further development of the axis East-West HST European axis.</td>
</tr>
<tr>
<td>Project</td>
<td>Local objective</td>
<td>National objective</td>
<td>European objective</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Madrid - Seville AVE</td>
<td>To build a new railway access to Andalusia in order to unlock the bottleneck point at Despenaperros.</td>
<td>Modernization of the whole existing railway network introducing HST trains. The aim was to connect all region’s capitals to Madrid within 4 hours and to Barcelona within 6 hours of journey time.</td>
<td>Development of the TEN-T priority axes in order to integrate Spain and Portugal into a fully interoperable trans-European HST network.</td>
</tr>
<tr>
<td>Eurotunnel</td>
<td>UK: to create a rail link between two terminals; the terminals had first to be connected to the rest of the country by road, and sometime later, by rapid train. France, to expand the French of HST network to the UK.</td>
<td>To create a transport link between the UK and the Continent. The link would benefit both France and the UK by improving accessibility and facilitating the transport of people and goods across the Channel.</td>
<td>To create an HST network which could connect Paris, Brussels, Cologne/Frankfurt, Amsterdam and London*.*</td>
</tr>
<tr>
<td>Baltic Sea Motorway</td>
<td>To enhance accessibility of the regions concerned by the project toward Berlin and Stettin and to the other main cities in the area. Hinterland access to the seaports and to ferry services.</td>
<td>The project belongs to the VDE reunification priority projects which principal aim was balance of the living standards between the West and East Germany.</td>
<td>To help establishing a powerful land transport connection from the EU economic centres to Finland and thus help to reduce the remote character of this Northeastern extension of the Union.</td>
</tr>
<tr>
<td>Malpensa Airport</td>
<td>To increase the Milan airport system capacity and to allow wide body aircrafts to operate on Milan. This would have stimulated an economic development a regional level.</td>
<td>To develop the Italian hub for intercontinental and international traffic and to move the flag career from Rome to Milan.</td>
<td>To create a gateway for international and intercontinental traffic in southern Europe.</td>
</tr>
<tr>
<td>Iberian electricity network interconnecti on</td>
<td>To improve competitiveness of the concerned regions and to enable local companies to access the Iberian Market Operator (Operador del Mercado Iberico or OMI)</td>
<td>SP and POR: To have free and equal bilateral trading conditions through the creation of the Iberian Market Operator (OMI).</td>
<td>Construction of an internal market of energy in the European Union to accelerate the application process of the regulations contained in the 96/92/EC and the 2003/54/EC Directives</td>
</tr>
<tr>
<td>The CH-IT electricity cross border connection</td>
<td>IT: to improve competitiveness for energy intensive companies in the region of Lombardy (thanks to more electricity available to better economic conditions) CH: to ensure electricity transmission and security of supply in the district of Bernina</td>
<td>CH: to develop the national power transmission network. IT: to increase import capacity from neighbouring countries and to progressively decrease electricity costs.</td>
<td>To reinforce and upgrade the cross-border electricity network of Italy and its neighbours.</td>
</tr>
</tbody>
</table>

Source: Our data processing

Legend: *The project was implemented before the development of the planning of PBKAL-HST network.
To better illustrate this point, the ICE Frankfurt-Cologne project could be picked up. Three distinct objectives face three distinct stakeholders.

**European perspective:**

As part of the high-speed corridor Paris-Brussels-Cologne/Frankfurt-Amsterdam-London (PBKAL) the linkage between Cologne and Frankfurt is a crucial part of an integrative European high-speed network. It is aimed at increasing the attractiveness of travelling by rail (European Commission, 2002) by offering substantial reductions in journey times and attracting passengers away from air travel and from road.

**National perspective:**

The national view associates further objectives with the new rail track. The Cologne – Frankfurt line connects the high-populated area of the Ruhr basin with the region around Frankfurt/Mainz/Wiesbaden. Both regions play a crucial role for the German economy. Therefore, the new connection is a core element of the national German high-speed network.

The new infrastructure has been designed for passenger trains. Before the opening of the new tracks the overall capacity on the old tracks has been exploited with the highest possible train frequencies. Growing freight volumes are still forecasted for the future, especially on the linkage between Rotterdam and Milan. The shift in passenger capacities from the old to the new tracks can be used for growing freight volumes.

**Regional perspective:**

The idea of involving Federal states in the evolution process for infrastructure investments ensures that regions also benefit from new connections. The case study at hand has two main objectives on a regional scale. First, the connection between Cologne and Frankfurt is expected to reduce resistances for shared labour and working markets in the area between the two cities. And second, the regions around the cities of Limburg, Montabaur and Siegburg/Bonn expected that with a direct connection to the ICE network a higher demand on the residential market as well as for commercial properties will occur.

The different concrete objectives of the three perspectives are all based on a reduction in travel time, which will lead to their expectations.

In general, The European level objectives are associated with the realization of some network rather than to a single project.

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5 The new tracks could theoretically be used for freight transport but in fact only passenger trains operating on the new tracks.
The EVATREN sample also provides evidence that project objectives could change over time. This could be the case when different stakeholders are involved and when the objectives lack of a strategic vision on how to integrate the transport infrastructure into the concerned network.

The objectives of San Fiorano Robbia Electricity interconnection, for example, are strongly depending on the time period and the geographical level / stakeholder considered.

At the time of first studies and discussions concerning the project, in the early 1980s, the objectives, as seen from the Swiss side, were clearly to ensure at the local level, the transmission of electricity and the security of supply in the district of Bernina. The main goal therefore was to connect the three major electricity production units located in Sils, Pradella and Robbia, in the South-East of the canton of Graubünden. Seen from a national point of view, at that time the objective of the project was to ensure the development of the national electricity transmission grid.

In 1997 the project was integrated in the Trans European Energy Network programme. However the TEN-E support only concerns the project from the substation of San Fiorano to the Swiss border. The objective of the European Union was to upgrade the overall European electricity network by reinforcing electricity connections to Italy from neighbouring countries. In this context, the objective of the project as seen from the Italian point of view was to ensure an increase of the Italian total import capacity. At the local level, the project aims at improving competitiveness of energy intensive companies in Lombardy by ensuring a higher power supply from economically interesting origins.

Since the project implementation in January 2005 (commissioning of the interconnector), one additional objective is the expected impact on Italian electricity prices. In deed, the increase of the import capacity due to the new interconnection with Switzerland is estimated to contribute to the homogenisation of power prices between Italy and its neighbouring countries, thus lowering the price of electricity for end consumers such as households and the industry.

2.1.1 Cross-cutting issues on project objectives

- Project objectives change with the stakeholders considered: the European Commission, the national and the regional/local authorities may have different objectives on the same project. This is a very common feature for all projects within the sample. The main challenge is to consider whether these objectives are complementary to or conflicting with each other.

- Objectives change over time. For the projects with very long decision-making processes, the reference context might change quite significantly and the original objectives could become obsolete or no longer feasible.

- Costs could be negatively affected from changes in project objectives. In fact this could lead to project redesigning and/or planning, as well as to the necessity for development of further analyses to appraise the changed conditions.
Despite the intrinsic difference in transport and energy project objectives, both categories are characterised by the common aspect of objectives changing over time and in respect of the stakeholder considered.

2.2 Decision making process

The decision making process for EVATREN projects has been a very complex task because the responsibilities for the decisions were dispersed among different authorities at very different levels: regional, national and supranational authorities.

The number of stakeholders involved in the process is high for all projects at hand: infrastructure owners, infrastructure operators, public administrators, regulators, users, non-users, etc. A large variety of stakeholders are already a good indication that the decision to invest in a major project will follow a complex path.

Commonly local authorities that have a good knowledge of regional conditions, deficiencies, requirements and potential benefits or risks initiate infrastructure plans. In case of national states this might be municipalities (e.g. Sweden), districts, regions or federal states (e.g. Germany). At the European level the entities proposing investment projects of Trans European interest are national states. The financing of investment projects is provided in most cases, by higher government levels such as national government and/or the European Union.

Given the numbers of potential interests that each level could have, a very well defined process which states the timing and the responsibilities of each stakeholder is envisaged in order to reach a sound decision.

Table 2.4 Most important dates by project

<table>
<thead>
<tr>
<th>Master plan</th>
<th>Inclusion in</th>
<th>Start date</th>
<th>Completion Date</th>
<th>Operative since</th>
</tr>
</thead>
</table>
In France, LOTI (Loi d’Orientation d’Aménagement et de Développement du Territoire) defines the general rules and steps for the development of transport infrastructures, governing the Transports infrastructure planning. LOTI provided the obligation for an ex-ante and ex-post assessment of implemented projects as well as the general methodologies for project evaluation. Subsequently modal specific Master Plans are drafted in order to specify the single investments to be implemented to reach the political objectives.

In Germany the problem is approached inversely because generally the need for new infrastructure is announced by local authorities. Then this feeds into the national master plan which in Germany takes the name of Federal Transport Infrastructure Investment Plan and (FTIP) which is carried out every 10 to 15 years. In addition the FTIP defines the methodology used for the assessment of the projects under examination in order to provide a competitive assessment of different alternative projects.

More specifically, the cycle of process for German railway infrastructure projects, is the following (Flyvbjerg, 2003):

1. rough estimation of benefits, costs and revenues within the standard evaluation procedure of the Ministry of Transport,

2. integration of the project in the German Federal Transport Infrastructure Plan for long distance infrastructure projects,
3. Start of detailed design of the project, check for spatial integration by the German federal states (Länder),

4. New requirements set by the federal states as preconditions to implementation,

5. New cost estimation carried out by a planning agency, control activity by the Federal sector specific Agency (e.g. Federal railway Agency for railways), revisions of forecasts, agreement between the German government and the sector specific network operator (e.g. Deutsche Bahn AG for railways) on cost sharing, establishment of financial plans and allocation of public payments to the future fiscal budgets,

6. Final design of the project, negotiations with communities, treatment of objections of citizens, expropriation process, new requirements set by the communities,

7. Construction of the project, reporting of actual cost development to a small group of officials from the involved agencies and the ministries of transport and finance as well as the network operator.

In every of the seven steps the project can be rejected or basic changes in design integrated.

Even in presence of well-established decision-making environment (as in Germany), sometimes and due to particular reasons, projects follow special procedures, which are developed in order to speed up its implementation. This has been the case of the Baltic Sea Motorway project. In fact it has been implemented in the framework of the German Unit Transport Projects (VDE projects) that were classified as priority projects since the German reunification in 1990. These projects were considered highly time sensitive and thus exempted from following the official planning procedure of the FTIP. More specifically in order to speed up their realization the “Planning Acceleration Act” was concluded which, together with specific investment measure acts, virtually excluded public claims in order to drastically reduce planning and construction times. In parallel, the German Unity Transport Infrastructure Financing Society (DEGES) was established in order to carry out planning and construction tasks on behalf of the Minister for Transport, Construction and Urban Development.

Contrary to the other projects, the Eurotunnel presents unique features in this respect as it has been the first of a series of big infrastructure projects meant to shape the backbone of TransEuropean transport networks. With some simplifications the picture of the involved actors is as follow:

- Policy Actors: French and British governments, with strong personal involvement of UK Prime Minister Margaret Thatcher and President François Mitterrand as well as the Department of Transport of the two countries. Policy actors encouraged the private sector to invest into Eurotunnel, but they did not commit their countries in financial terms.

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6 German national railway operator
• Regulatory Agencies: To supervise the project on their behalf, the governments of the two countries that granted the concession have established the Inter Governmental Commission (IGC), a French-Britain co-operation body of the governments. Decisions are taken in common agreement between the delegates. In case no agreement is reached, then the contentious is passed to both governments.

• Institutional Bodies: Three bodies have been created to regulate the relationship between both states and Eurotunnel: the Inter Governmental Commission (IGC) (see above); the Safety Authority, and the “Tribunal arbitral”. These three bodies represented, directly or indirectly, the interests of the citizen. But without another body, the banks, Eurotunnel would either not have been built at all or it would not have been built as a fully private infrastructure.

The Safety Authority was a joint body between French and British instances (at parity). The SA advised the IGC on safety matters and, therefore, has had a very strong power over technological decisions.

The Arbitral Court was a legal institution with the duty of solving litigations between the states as well as litigations between a state and a franchiser, or between franchisers.

The banks were the key players of Eurotunnel: they produced the 1984 report upon which all initial financial decisions were taken, they subscribed to equities 2 to 4 and the Bank of England did put Sir Alastair Morton at the head of Eurotunnel. After operations have started, they more than once negotiated the debt and set conditions for Eurotunnel management.

• Regulatory and Policy Framework: The main regulatory framework is the Canterbury Treaty, signed on February 12, 1986 by the French and the British ministers of foreign affairs. The Treaty states the strategic specificities of the project, namely the line between land borders, defence, security and safety requirements. Then, the Concession Act, signed on March 14, 1986, specifies technical requirements of the project; it also states the concession holder’s freedom of management and of operation.

• Project Complexity: In addition to the difficulties inherent to any large-scale project, Eurotunnel had a structure where all tasks were duplicated, everything being made so that each half of the tunnel would be built by a French or a British company, each operating under its own national law.

Duplication of all entities made the project very difficult to manage, not only due to the number of groups involved, but also because it was extremely difficult to build trust between duplicated managers. Winch (1998) quotes Colin Stannard, Managing Director Eurotunnel: “There is, I believe, a fundamental error in the nature of the construction contract which led to lack of trust on both sides”.

Coordination was particularly difficult, not only due to different laws, different philosophies of work, but also because of the lack of experience. None of the managers or of the team members
had accomplished such a task before whereas state-owned industries like BR (British Railways) and SNCF (Société Nationalle Chemin de Fer) were barred from the project despite all their expertise.

2.2.1 Cross-cutting issues on decision making process

- The decision-making processes are strongly country-specific. Projects belonging to the same country followed very similar processes. This is particularly true for the German and French projects, which followed their own country procedures, which were established well in advance by the transport planning authority.

- When specific decision making processes exist, these tend to ensure that the project financing decision is taken when all stakeholders have been consulted and when the requested information and analyses have been undertaken and submitted.

- Since project decision-making processes are country-specific, projects belonging contemporarily to more than one country did not followed a homogenous procedures and could have been evaluated using country specific criteria.

- Since decision making processes are country specific, projects belonging to different TEN-T axis followed different paths and were assessed using diverse methodologies.

- There is a direct correlation between the high number of stakeholders and the length of the process.

2.3 Context analysis

Transport and energy infrastructure networks may consist of interdependent projects (DG Regio 2002). More specifically different projects might compete with each other, while in other cases they might be complementary. The concepts of accessibility and projects interoperability are strictly linked to project interdependency. The first refers to the fact that a full accessibility in physical terms toward and from the facility should be ensured. The second refers to railway networks and stresses the fact that there should be no barriers for trains to circulate on different rail networks (e.g. from the French rail network to the Spanish one).

2.3.1 Interdependency

The EVATREN sample puts forward good evidence as far as the issue of interdependency among the projects is regarded, both at European as well as at national level.

Three projects in the EVATREN sample (The Eurotunnel, the Paris-Lille TGV and The ICE Frankfurt-Cologne HST) belong to the high-speed railway axis Paris-Brussels-Cologne/Frankfurt-Amsterdam-London (PBKAL), which is one of the fourteen projects of the
Trans European Transport Networks, endorsed by the European Commission in 1994. All fourteen projects are defined as main corridors, which play a vital role in establishing an efficient land transport linkage between major European regions (European Commission, 2002) (See Figure 2.1).

**Figure 2.1 TEN-T project Paris-Brussels-Cologne/Frankfurt-Amsterdam-London**

Following the experience of the Paris-Lille TGV it is in clearly evident the extent to which this issue could matter. In fact throughout the whole appraisal process of this project, the issue of interdependency have always been taken into account.

The first report on the project dates back in 1974 and it states that the project is strongly linked to the construction of the Channel Tunnel. Furthermore, the Channel Tunnel is also mentioned in the reports of the international working group of the link Paris-Brussels-Cologne-Amsterdam. In the DUP 1988 (Declaration of public Utility) the issue was raised again by assessing that the North High Speed line would not have been profitable without the Channel Tunnel and its further extension to the East.

In the Options analysis, the reference situation for the assessment of incremental benefits considered two options - a without Channel Tunnel and a without HST option. The “with the project” situation was conversely fixed with the Channel Tunnel opened for the Eurostar and with the HST network implemented toward Brussels and Amsterdam (See chapter 5 on Options analysis for further information).

As for the demand analysis, the total traffic on the Paris-Lille HST line has been divided by users’ destinations in order to quantify the net effect on total traffic provided by the different
parts of the network. Of 31.1 million passengers on the line, nearly 50% was dependent on the realization of the Channel Tunnel, while nearly 17% on the implementation of other parts of the HST line. (See chapter 6 on demand analysis for further information).

Within the demand analysis, project dependency does matter to identify the proper competitors to the project. The Paris-Lille HST is a 200 km infrastructure, which could be better evaluated as a semi-local line. Due to this the main competitor of the line is the road, however if we look to the line Paris-London, the main competitor becomes the airplane.

To provide an accurate assessment of the diverted traffic is important because it directly influences the financial performance of the project. For example, following the ex post assessment of the French project, the air tariffs from Paris to London have been over estimated by almost 70% leading than to an overestimation both of the traffic on the French HST line and consequently of its revenues. (See chapter 7 on financial analysis for further information).

Finally, the economic performance of the project might be concerned as well. Following the project’s ex-post analysis, it has been stated that its economic rate of return would lower if a reduction of the Channel Tunnel tolls would not occur in 2007. In fact Eurostar is operated by the SNCF and pays tolls to pass throughout the Channel Tunnel. Not reducing the tolls would lower the economic performance of the project by 0.5%, leading to a rate of return of 2.4%.

### 2.3.2 Accessibility

Project accessibility is a key feature in order to exploit the full potential of a project. For the Lyon-Marseille TGV, for example, regional accessibility has been considered at two levels:

- Accessibility by road in particular for the new stations, which are outside the city of Marseilles, Avignon, Valence or Montpellier;
- Accessibility with regional rail services.

This has been a direct consequence of the fact that the national planning process is coupled with the regional planning process within the regional transport master plan: regions are consulted and integrate national decisions within regional plans.

As far as the Baltic Sea Motorway is concerned, the accessibility issues were considered directly in the high level designing of the VDE projects plan. In fact the whole VDE plan comprised a number of accesses to link the project to the existing German transportation network. The “Rügen Access Link” (B96) was designed and implemented to provide a western connection to the city of Rostock with its important Baltic Sea port. The project was completed in 2003. In addition local accessibility has also been taken into account and has been seen as a crucial factor for the economic success of the A20. For this reason a high density of motorway exits has been implemented. The average distance between two access points is 10 to 15 km in average.
The issue of accessibility is of major importance when a project does not have a “physical continuity” with the existing network. E.g. for Malpensa, the success was partially linked to some complementary projects, which ensured its accessibility. Since the beginning the surface accessibility has been seen as a potential weakness and cause of constraints for the project development (Italairport, 1985; Centro Studi PIM, 1993; Odoni, 1993; Centro Studi PIM, 1998; Giannelli, 2003). In fact, the lack of an existing road and rail network to Malpensa was potentially capable to make the whole potentiality of the airport ineffective. Mainly the Regional Government through dedicated plans and agreements has managed the planning of the access features. Although the two fundamental direct accesses have been soon realised, both the perception and the actual access time make Malpensa a “far” infrastructure from a large part of its catchment area. This is also due to the fact that a large part of the planned infrastructures are still lacking or in construction. Furthermore, it should be noticed, that the project is unlinked from the designed high speed train network, avoiding positive integration between the two systems.

2.3.3 Interoperability

Project interoperability refers to the technical standardisation and harmonisation of infrastructure equipment and rolling stock in order to allow trains to run over several network (DG Tren 2006). This is a very recent and crucial issue in order to fully exploit the potentialities of railway networks throughout Europe, but also as far as national networks are regarded.

The Madrid-Seville HST dealt with the problem of interoperability since the early stages of the project planning. In Spain, track gauge was at the time larger that the international gauge (1435 mm instead of Spanish gauge of 1668 mm) and the Madrid-Seville HST was the first HST line to be implemented in Spain.

The approval of the introduction of the international gauge on the construction of the new high speed train lines by the Ministries Council on 9th December 1988 showed the willingness of the Spanish Government to take the opportunity to integrate its high speed train network to the trans European railway network. However, this has raised an interoperability problem with the rest of the existing network, which still uses the Spanish gauge. This problem was partially solved by the operation of flexible gauge trains. For example, the Talgo 200 (starting in the early nineties), which serve the Madrid-Córdoba-Malaga line. This train runs on high speed international gauge tracks until Córdoba, changes its gauge into Spanish wide in Córdoba station and runs on Spanish gauge until Malaga. This change needs approx ten to fifteen minutes.

Also in the French cases the interoperability issue has been stated since the beginning of the HST network implementation. The issue was raised for the national network as well as was a precondition for the future integration of a European HST network.

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7 DG Tren (2006), Toward an integrated European railway area – Cross acceptance of rolling stock, Brussels.
Evidence from these two cases show that interoperability is not a project specific but a strategic decision, which should be discussed during the network planning stage. Today this issue is one of the first points in the DG Tren agenda regarding European railway network development involving technical features (such as the gauge) as well as external elements on a policy/regulation level. These are for example the homogenisation of signalling systems, number of operators in trains and so on.

For national network interoperability, the case of the ICE Frankfurt-Cologne provides good insights as the construction of the line faced the problem of interoperability with nine stations (existing and new built) connecting the regional transport networks along the new tracks with the long distance passenger HST network of the Deutsche Bahn AG.

### 2.3.4 Cross-cutting issues on context analysis

- The majority of the projects in the sample belong to networks at international and/or at national level.

- When projects belong to networks the issue of project dependency is very relevant. In fact, in such a situation, project financial and economic performance could be strongly influenced by the implementation and the operation of other networks.

- Project dependency issues have never been analysed with sensitivity analyses and/or scenario analyses to consider the potential differences when other projects are delayed or not implemented at all.

- Project accessibility was revealed to be a crucial point that can strongly influence the project’s performance.

- Interoperability is a crucial issue for the implementation of European-wide railway networks. This could operate at national level to enable the integration of new projects within the regional as well as the local railway system.

### 2.4 Options analysis

For eight projects options analyses were carried out and data have been available. Looking at these projects it has been noted that two different approaches exist:

- A first group of projects has an Options analysis aimed at investigating the potential economic benefits that each alternative could generate;

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8 Cologne main station, Cologne-Deutz, Cologne/Bonn airport, Siegburg/Bonn, Montabaur, Limburg-Süd, Frankfurt airport, Wiesbaden main station and Frankfurt main station
The second group of projects provides Options analysis which goes beyond the economic perspective and includes the evaluation of alternative technical solutions to reduce environmental impacts of the project.

The Waterway Cross Magdeburg, the two French HST projects and the Eurotunnel belong to the first group of projects. The analysis is strictly economic and different solutions are evaluated on the basis of their ability to generate incremental benefits against the reference solution. A do-nothing, a do-minimum and a do-something solution have been developed and compared. The reference solutions are identified as a “do-minimum” option because the inertial scenario would have led to congestion of the network, asking for investments to maintain or renew the existing infrastructure.

For the Eurotunnel, for example, four technical alternative were put forward:

1. Channel Tunnel Group (later to become Eurotunnel): twin bored large, 7.3 metre (later 7.6) diameter, tunnel carrying shuttle and through trains. The consortium was composed of 10 contractors (5 French, 5 British), named Trans-Manche Link (TML) and five banks (2 British and 3 French);

2. Euroroute: a bridge/tunnel scheme comprising bridges from each coast linked by a submerged tube tunnel 21 km long carrying a motorway, plus a bored small-diameter tunnel system for through trains, which would be built in stages;
3. Eurobrige: a bridge scheme comprising a motorway in an enclosed tube suspended from piers in spans 4.5 km in length, using advanced plastics technology; a rail link could be provided either on the bridge, or in a small diameter tunnel;

4. Channel Expressway: twin very large bored tunnels, 11.3 metres in diameter, carrying both motorway and rail traffic (later modified to comprise separate rail tunnels), using advanced ionization techniques to remove noxious gas from road vehicles.
Assessors evaluated the four serious candidates in terms of technical viability, financial robustness and environmental impact. BLWG (Braibant-Lyall Working Group, BLWG, 1981-1982) state they have used the following methods:

- A retrospective comparison of the ex-ante and forecast data from 1971-1975 studies with the data observed in 1980;
- Scenarios method to do an ex ante economic and social assessment of different alternatives;
- Energy and environmental assessment of the different alternatives on both sides of the Channel.

A key player in option choice was the Franco-British Channel Link Financing Group (the “Banking Group”) that had been set up by UK and French governments in 1982. The Banking group\(^9\) (1984.) based its choice on the capacity of the project to generate sufficient revenue over a predictable period of economic life (taken to be 25 years of operation) to repay all financing requirements. On the basis of its analyses, the Banking Group came to the conclusion that the Channel link scheme with the highest financial viability and robustness to sensitivity tests coupled with minimum technical and operational risk is the concurrent building of dual bored tunnels.

Drive-through schemes were considered attractive for users but too expensive to build and technical issues during construction and as well as potential major failures during operations made the Banking Group consider that the financial market would not assume the construction risk.

Phased construction (one tunnel, then the other) was considered unacceptable as it would have increased the ultimate cost and because it would not generate sufficient revenues to be viable.

As far as the second group of projects is concerned, the Options analysis has been used to identify the most suitable design to reduce environmental impacts of the project. In this sense the Options analysis could be seen as a strategic planning tool that could enter into many different phases of project design.

For the Baltic Sea Motorway, in fact, the process of the Options analysis entered into the three planning stages followed by the project:

- the strategic planning concerning whether to built or not to built the road,
- the regional planning concerned where to place geographically the new motorway,
- the local planning concerned the dimensioning and the technical features of the road.

The Options analysis considered an upgrade of the existing network as well as an investment into the new motorway.

The regional planning regarded three different routes: a Northern route passing by Stralsund at the Baltic Sea coast; a Central route passing by Rostock; a Southern route passing by Neubrandenburg.

The local planning regarded the concrete horizontal and vertical alignment of the road, its dimensioning and how to meet the challenge of protecting the environment and the inhabitants from the adverse impacts of traffic. However this final stage mainly brought to the decision on whether to bridge large parts of the road or the construction of so-called “green bridges”, which were not foreseen in the initial planning process but were developed and assessed in a second instance. Both solutions are more environmental friendly than a ground implementation of the road. The lesson learned from the Baltic Sea Motorway is that the set of options may change during the construction process due to the its flexibility and that the options analysis should take into account all the effects that a solution may generate. Different alternatives should be considered to address specific problems and to compare their costs and benefits.
Among the “do-something solutions” of energy projects Options analysis, many alternatives can be investigated, such as different technologies for transporting electricity, alternatives routes for gas pipelines, different district networks or the construction of some power generation plant. Both projects present an options analysis, whilst they differ widely in the approach used. This concerned whether to build or not the interconnection and which kind of do-something solution would have been the most suitable. The alternatives were then compared on the basis of the maximum capacity they would have sustained without breaking some security criteria. Thus, this analysis was intimately linked with the security criteria analysis and then it is treated in that section of the present document.

As for this latter project, four route alternatives have been considered for the interconnection between the power station of San Fiorano and the Swiss border:

- Alternative 1: Starting out the San Fiorano power plant in the Northeast direction, the line joins the Swiss border after having crossed 13 communes, the Mortirolo pass (1,852 m), the Oglio River twice and the Adda River once. The route is 37 km long.

- Alternative 2: The second options starts from San Fiorano in the West direction and avoids the habitations of Sellero. The line climbs towards the Val Paisco (between 1,300 m and 1,600 m) and then to the North of the Monte Tre Confini (2,590 m). In total, the line crosses 10 communes, the Adda River once and is 36.3 km long.

- Alternative 3: The beginning of this route is common with Alternative 1, but the line follows the existing 380 kV power line Edolo – San Fiorano in the North direction. In the area of Edolo, the line turns to the West direction. The highest point is about 1,700 m, the line is 36.4 km long and crosses 10 communes.

- Alternative 4: The last option considered starts out just like Alternative 1, but climbing to about 2200 m, then going down to Tovo di S. Agata and ending with the same route as Alternative 1. 11 communes are crossed and the total route length is 36.2 km.

A comparative analysis of these options has been realised, including qualitative and quantitative analyses, leading to the selection of the most relevant route on the basis of several indicators and criteria. The main limit of the analysis is that it considers only local alternatives between the power station of San Fiorano and the Swiss border. Several reasons can be given to explain why the specific San Fiorano – Robbia electric line was built:

- Electric interconnections needs to exist between Italy and all of its neighbours, so that the concurrence stays relatively low between a new connection e.g. with Switzerland (San Fiorano - Robbia) and with Austria (Cordignano - Lienz).

- High voltage transmission lines are built between two electric power stations with high capacities, so that the highest possible flexibility occurs between the national electricity supply and the cross-border power transmission, depending on the level of the national demand and the import/export needs at the time period considered.

- The choice of the Robbia and the San Fiorano power stations is relevant regarding the network connections with existing transmission lines in Switzerland and Italy. In fact, the new line is connected to the substations of Filisur and La Punt on the Swiss side. These connections enable a high voltage transmission between the 3 main power stations in the South-East of the canton of Grubünden: Sils, Pradella and Robbia. On the Italian side, the new transmission line is connected to the substation of Edolo, Nave, Piancamuno and Gorlago, thus significantly increasing the quantity of electricity available to economically interesting conditions in the region of Lombardy.
2.4.1 Cross-cutting issues on option analysis

- Options analysis focuses on the strategic project design. In fact it mainly deals with the issue of whether to implement a project or not or whether to choose between different alternatives to address the objective at stake;

- Only alternative routes, and not alternative modes, are considered in the analysis.

- For some projects, such as the Waterway Cross Magdeburg and the Lyon-Marseille TGV, the options analysis strictly aims at investigating the potential economic benefits that each alternative could generate. In these cases the alternatives were evaluated using the same methodology and computing the same performance indicators. This allowed a direct comparison between alternatives.

- The analysis of the Baltic Sea Motorway provides evidence of a different approach, which includes the evaluation of alternative technical solutions to reduce environmental impacts of the project.

2.5 Demand analysis

The estimation of the existing demand and its forecasts of the future is a complex and critical task that often consumes a substantial part of the resources allocated to the feasibility study.

The volume of the demand could implicitly provide the “size” of the entire project:

- Technical design depends on the expected traffic,

- Project financial viability lies on total project’s traffic assumptions,

- Project users directly influence economic benefits to the society.

All EVATREN transport projects rely on a comprehensive demand analysis; however the methodologies used to develop the forecasts, as well as their level of robustness against actual figures of traffic, vary widely among the sample.
Table 2.5  Features of the demand analyses in the sample

<table>
<thead>
<tr>
<th>Demand analysis</th>
<th>Carried out</th>
<th>Available/Public</th>
<th>Existing demand considered</th>
<th>Diverted demand considered</th>
<th>Induced demand considered</th>
<th>Competition taken into account</th>
<th>More than one demand analysis produced</th>
<th>Scenario analysis of the demand</th>
<th>Over-estimation occurred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterway Cross Magdeburg</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Oeresund Fixed Link</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>ICE Frankfurt - Cologne</td>
<td>Yes</td>
<td>No</td>
<td>Yes*</td>
<td>Yes*</td>
<td>Yes*</td>
<td>No</td>
<td>N.a</td>
<td>Yes*</td>
<td>N.a</td>
</tr>
<tr>
<td>Paris - Lille TGV</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Lyon - Marseilles TGV</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Madrid - Seville AVE</td>
<td>Yes</td>
<td>No</td>
<td>Yes*</td>
<td>Yes*</td>
<td>Yes*</td>
<td>N.a</td>
<td>N.a</td>
<td>N.a</td>
<td>N.a</td>
</tr>
<tr>
<td>Eurotunnel</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Baltic Sea Motorway</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>N.a</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Malpensa 2000</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Source:  Our data processing.

Legend: *The analysis is not publicly available, however in compliance with the official methodology, these items may have been calculated.

In the light of the experiences gained from accuracy of demand, forecasting in the transport sector, covering traffic volumes, spatial traffic distribution and distribution between transport modes, there is evidence that demand forecasting is a major source of uncertainty and risk in the appraisal of major projects.

The evidence from the case studies highlighted that an ex ante demand analysis was developed for all projects within the sample, but with deviations from the international benchmark practice, in particular with regard to the consideration of the competitive scenario. In addition, the methodologies used to develop forecasts as well as their level of robustness against actual figures vary widely among the projects.

As regard energy projects, different tools have been used to estimate future electricity demand.

The more accurate is the specific system of demand estimation (SIPREDE) used by the IBELM project, which is based on macroeconomic scenarios and takes into account different variables, such as workable days, temperature, GDP growth, prices and elasticity to GDP and prices. Whereas, in the case of the San Fiorano-Robbia the use of the PERSEUS energy and material flow model has been decided by the EVATREN consortium in order to reassess the demand...
analysis, which did not constitute an official analysis of the San Fiorano – Robbia interconnection. Even if both projects are still “young” and the accuracy of the electricity demand estimation is to be checked further, these estimates are probably less susceptible to deviations than those in the transport cases because the projects undergo significantly lower competitive pressure, especially since they are electricity distributors and not generators.

Regarding transport projects, actual demand has been overestimated for almost all projects within the sample (seven over nine). This is a frequent feature in the transport sector and can also be observed in the EVATREN sample. The main drivers for demand overestimation were shortcomings in the assessment of the project context as well as underestimation of the competitive scenarios.

As far as the methodological approach is concerned, demand is not broken down by traffic composition. Available material on the Baltic Sea Motorway indicates that a single stock of traffic was considered without any specification of how much of the total was existing, diverted and/or generated demand.

The point about inappropriate estimation of the project context is linked with the previous one. As a matter of fact, in nearly every case the tendency to overestimate the macroeconomic context in which the project was implemented has been identified. This situation led to the forecasting models being fed with figures that were inflated, thus leading to overestimation of traffic demand. The German cases, for example, were based on macroeconomic indicators as well as on transport-specific figures that were delivered by the national transport planning agency. The utilisation of these data, which ex ante appeared to be much higher than real figures, led to an overestimation of the actual demand in these projects.

Competition proved also to be one of the variables that affected demand overestimation. In some cases in particular the competition issue was not considered at all within the demand analysis (Baltic Sea Motorway, Malpensa 2000, ICE Frankfurt-Cologne). The effects of competition on final demand are generally very difficult to estimate and to model. In addition a project may compete with different modes of transport, considered alone and also as part of a network. The case of ICE Frankfurt-Cologne showed that the single line is in competition with the motorway on a national level, but it competes with air transport inasmuch as the project is considered as part of PBKAL HST network. The same could be said about Paris-Lille HST, as it is in competition with the road (it also has the objective of decongesting the highway on that route) as well as with air transport, if it is considered in combination with the Eurotunnel project.

In two cases (Oeresund Fixed Link and Madrid Seville AVE) the adoption of adaptive pricing policies on project services reduced deviations between ex ante and actual demand. In the case of the Oeresund fixed link a strategic policy on the average price (e.g. frequent traveller discounts) has been applied in response to demand lower than expected.

In no cases have the demand analyses been tested for price variations of tariffs in competitive modes nor have scenario analyses for demand figures been developed.
Finally, it is to be noted that the influence of “unexpected” events on actual demand also proved to be very high. In particular, price variations of fuel, changes in sector policies, terrorist attacks, etc. affect the ex post consistency of demand forecasting. For example, the effects of terrorist attacks strongly affected the Malpensa project as well as the Madrid-Seville HST even if both projects showed a good ability to react to these shocks. The same is true for fuel price variations, which may influence the modal choice of the users.

### 2.5.1 Cross-cutting issues on demand analysis

- Actual demand has been overestimated for almost all projects within the sample.
- The main drivers for demand overestimation were shortcomings of the project context as well as underestimation of the competitive scenarios.
- Since the nature of error is systematically optimistic, it is reasonable to assume that inaccuracy is the result not only of technical weaknesses (although the methodologies used are not always updated to international standards), but also to the need to demonstrate ex ante the convenience of the project. In other words, it is the objective itself that generates the error.

### 2.6 Financial analysis

#### Transport sector

Table 2. 6 Forecasts and actual cost for EVATREN projects (in million EURO)

<table>
<thead>
<tr>
<th>Project</th>
<th>Forecast</th>
<th>Actual</th>
<th>Overrun (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICE Frankfurt - Cologne</td>
<td>2784</td>
<td>6015</td>
<td>116%</td>
</tr>
<tr>
<td>Eurotunnel</td>
<td>2702</td>
<td>4568</td>
<td>69%</td>
</tr>
<tr>
<td>Oeresund Fixed Link</td>
<td>1795</td>
<td>2924</td>
<td>63%</td>
</tr>
<tr>
<td>Paris - Lille TGV</td>
<td>2666</td>
<td>3334</td>
<td>25%</td>
</tr>
<tr>
<td>Madrid - Seville AVE</td>
<td>3263</td>
<td>4029</td>
<td>23%</td>
</tr>
<tr>
<td>Magdeburg Waterway Crossing</td>
<td>2064</td>
<td>2435</td>
<td>18%</td>
</tr>
<tr>
<td>Lyon - Marseilles TGV</td>
<td>4015</td>
<td>4338</td>
<td>8%</td>
</tr>
<tr>
<td>Malpensa 2000*</td>
<td>990</td>
<td>945</td>
<td>-5%</td>
</tr>
<tr>
<td>Baltic Sea Motorway*</td>
<td>2200</td>
<td>1830</td>
<td>-17%</td>
</tr>
</tbody>
</table>

Source: Our data processing

Legend: *In the cases of Malpensa 2000 and Baltic Sea Motorway the comparison between forecast and actual costs is uncertain because of changes in project scope and physical boundaries. Source: Our data processing.
As reported from a wide literature on transport project analysis cost overrun is a very common feature of transport project implementation. The main cause for it is a lack of realism in initial cost estimates. The length and cost of delays are underestimated, contingencies are disregarded, changes in project specifications and design are not sufficiently taken into account, changes in exchange rates between currencies are underestimated or ignored, so is geological risk, and quantity and price changes are undervalued as are expropriation costs and safety and environmental demands (Flyvbjerg, 2003).

The EVATREN sample provides further examples because every project, but two, experienced an overrun of construction costs. Potential causes for the cost overrun can be found among the reasons listed above. However as Table 7 points out, it is not possible to find one single reason for the deviations but different factors occurred for the case studies.

### Table 2.7 Main causes of errors in costs estimation

<table>
<thead>
<tr>
<th></th>
<th>Magdeburg Waterway Crossing</th>
<th>Oeresund Fixed Link</th>
<th>ICE Frankfurt-Cologne</th>
<th>Paris-Lille HST</th>
<th>Lyon-Marseille HST</th>
<th>Madrid-Seville AVE</th>
<th>Euro tunnel</th>
<th>Malpensa Airport</th>
<th>Baltic Sea Motorway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delays in implementation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changes in project specifications &amp; design</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Changes in rates between currencies</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Geological risk</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changes in quantity and prices</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underestimation of expropriation costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changes in safety requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Changes in environmental requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technological risks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Our data processing.

The ICE Cologne Frankfurt HST could be a very meaningful case, as most causes stated in Table 2.7 can be observed for this project, where the costs more than doubled.

On the contrary, some cases can be found where cost overrun occurred only to a minor extent or even not at all. The analysis of the Baltic Sea Motorway and the Lyon-Marseille HST show that management mechanism during project implementation allows cost saving, while

As for the Baltic Sea motorway, a full ex ante and ex post financial analysis is not available. Planned costs were estimated at 2.2 billion EUR (current prices), while actual costs amounted to 1.83 billion EUR. According to DEGES this savings can be attributed to two facts:
• **Construction organisation:** The original procedural plans have foreseen that all construction companies would directly be responsible and would be governed by the DEGES. According to staff restrictions, however, the procedure turned out not to be manageable in practice. The DEGES has then subdivided the A20 into 24 building sections and for each section one single general construction contract was tendered. This procedure gave the DEGES first a better control of the overall costs and second it drastically lowered its own management costs.

• **Environmental concerns:** In the original plans, it was foreseen to bridge large parts of the A20. This was a decisive cost driver as roughly ¼ of the area of Mecklenburg-Western Pommerania belongs to a very environmentally sensitive area. The DEGES, however, developed a new concept of green bridges and tunnels, which allowed building the motorway on ground level while fulfilling the needs of nature conservation. This concept of green bridges became very popular and now is part of the official infrastructure development guidelines of the German government. Further it has saved significant construction costs and will further save the expensive maintenance obligations of motorway bridges.

The experience from the Lyon-Marseille TGV line show that lessons drawn from similar projects in the past could help to overcome uncertainties and therefore to limit cost overrun.

Costs of the project are shown in Table 2.8\(^\text{10}\). Given the financial value of the investment and the expected revenues, the financial rate of return amounts to 6.8% on a time horizon of 20 years.

**Table 2.8  Lyon-Marseille TGV construction cost**

<table>
<thead>
<tr>
<th></th>
<th>New line</th>
<th>New stations</th>
<th>Invnt annex(^\text{11})</th>
<th>Rolling stock</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial budget</td>
<td>3275</td>
<td>166</td>
<td>245</td>
<td>329</td>
<td>4015</td>
</tr>
<tr>
<td>Final cost</td>
<td>3332</td>
<td>210</td>
<td>320</td>
<td>476</td>
<td>4338</td>
</tr>
<tr>
<td>Deviations (%)</td>
<td>2%</td>
<td>27%</td>
<td>31%</td>
<td>45%</td>
<td>8%</td>
</tr>
</tbody>
</table>


The initial budget in Table 2.8 is the budget estimated in 1995 before the final decision has been taken. After 1995 the modifications asked by the state were limited (around 1%), concentrated on measures to be taken concerning flooding and seismic risks, recalling a strict application of the law in force (and not imposing new measures).

\(^{10}\) The Financial Net Present Value of the Investment has been estimated with a discounting rate of 8%. The costs ex post analysis has been conducted by the “Cour des Comptes” (The French institution which controls public expenses), however the project incurred also into some extra expenses due to unexpected difficulties met in the construction itself resulting mainly from insufficient preliminary studies concerning the underground investigations on purchased land.

\(^{11}\) Investments annex (investissements connexes in French) are investment not situated on the new line but necessary to the good functioning of the network when the new line is working (maintenance and repairing units for example…)
Therefore the initial budget has been respected within a margin of 5 % (if we exclude rolling stock cost difficult to appreciate), which can be considered as rather outstanding as regard to the size of the project.

The main drivers for this limited cost overrun are:

- The first construction contract passed at a lower price than estimated (25% lower on average) because of low level of activity in the construction sector at the time.

- Operation started with “only” one year of delay.

- A specific management effort was put in place in order to prevent costs from exploding. More specifically the RFF (Network operator) and the SNCF (railway operator) were put in shared responsibilities on the project. In order to control costs and ensure the transparency of project operations, they appointed a dedicated team. This gave the chance for a close control on costs imposing for example a formal justification and new authorization when costs exceeded 5% of the initial estimations, when such “formal” procedure was not required below 25% deviation.

The experience of the Oeresund fixed link is of particular interest because investment costs as well as maintenance and operating costs are financed by loans raised on the national and international financial markets. According to the project’s legal basis the loans have to be repaid through tools for passage. Both modes of transport (road and rail) shall be included in the repayment process. The repayment period has been calculated by Oeresundsbro Konsortiet and is updated yearly because of strong correlations between user numbers and repayment amounts. The original profitability calculations for different scenarios are based on the following assumptions (Oeresund Konsortiet, 1995):

- Construction costs of 1.795 million ECU (fixed price level July 1990),
- Commissioning of the fixed link July the year 2000,
- Road traffic of 10,000 vehicles per day in the year of commissioning,
- Traffic growth rate of 1.7 percent in the first 20 years after commissioning,
- Tolls for passage which based on the legislative basis of the Oeresund fixed link is 22 ECU per car-unit (price level July 1990),
- Payment from national Swedish and Danish railway companies of 41 Million. ECU for access to the link (price level July 1990),
- Real interest rate of 4 % during the entire period and
- Cost for operation and maintenance of 16 million ECUs (price level July 1990).

Based on these assumptions the repayment period has been calculated to 24 years and a real rate of return of 6.3% after 60 years (Oeresund Konsortiet, 1995).
The assumptions above for the calculation of repayments and return on investment can be defined as conservative numbers. Especially the demand growth rate, which has extensive impacts on the success of a long-term project, has been defined cautiously.

Results of the actual financial situation are strongly dependent on traffic numbers and their revenues. With increasing amounts of revenues from road and rail traffic since the opening in 2000 also the profit before depreciation and financial items increased significantly to 1,251 million DKK (approx. 168 million EUR) (Oeresundsbro, 2007). Road traffic revenues have been above budget whereas rail revenues are defined in the original government agreement with DKK 300 million (1991 prices), which leads to DKK 421 million in 2006 (approx. 57 million EUR). Other revenues largely comprise payments for the use of the link’s fibre optic cables and mobile telephone system (see Table 2.9).

Table 2.9 Profit/loss development of the Oeresund fixed link

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Road traffic revenue</td>
<td>556</td>
<td>598</td>
<td>668</td>
<td>729</td>
<td>820</td>
<td>912</td>
</tr>
<tr>
<td>Rail revenue</td>
<td>393</td>
<td>403</td>
<td>408</td>
<td>412</td>
<td>421</td>
<td>429</td>
</tr>
<tr>
<td>Other revenue</td>
<td>20</td>
<td>20</td>
<td>11</td>
<td>13</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total revenue</strong></td>
<td>969</td>
<td>1,021</td>
<td>1,087</td>
<td>1,154</td>
<td>1,251</td>
<td>1,352</td>
</tr>
<tr>
<td>Operating costs</td>
<td>283</td>
<td>282</td>
<td>269</td>
<td>276</td>
<td>281</td>
<td>294</td>
</tr>
<tr>
<td>Profit before depreciation and financial items</td>
<td>686</td>
<td>739</td>
<td>818</td>
<td>878</td>
<td>970</td>
<td>1,058</td>
</tr>
<tr>
<td>Depreciation</td>
<td>320</td>
<td>320</td>
<td>322</td>
<td>322</td>
<td>324</td>
<td>340</td>
</tr>
<tr>
<td>Net financing costs</td>
<td>757</td>
<td>780</td>
<td>676</td>
<td>697</td>
<td>759</td>
<td>835</td>
</tr>
<tr>
<td><strong>Result before value adjustment</strong></td>
<td>-391</td>
<td>-361</td>
<td>-180</td>
<td>-141</td>
<td>-113</td>
<td>-117</td>
</tr>
<tr>
<td>Value adjustment, net</td>
<td>-618</td>
<td>363</td>
<td>-447</td>
<td>-402</td>
<td>682</td>
<td></td>
</tr>
<tr>
<td><strong>Profit/loss for the year</strong></td>
<td>-1,009</td>
<td>2</td>
<td>-627</td>
<td>-543</td>
<td>569</td>
<td></td>
</tr>
</tbody>
</table>

Source: Oeresundsbro, 2007

The development of road revenues, which are completely dependent on the number of vehicles on the link as well as tariffs to be paid are shown in the following table. It can be seen that the revenues increased constantly over time.
**Energy sector**

No detailed financial analysis, for both the projects could be found on the basis of the documents collected and the stakeholders interviewed.

Only the total investment figures for each line are available (Table 2.10).

**Table 2.10 Investment costs of the two lines**

<table>
<thead>
<tr>
<th></th>
<th>Total Costs</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Forecast</td>
<td>Actual</td>
</tr>
<tr>
<td>CH-IT Electricity Interconnection</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>Iberian Electricity Interconnection</td>
<td>n.a.</td>
<td>28</td>
</tr>
</tbody>
</table>

Source: Our data processing

Both projects received a financing from the European Commission. The San Fiorano-Robbia line was supported with 0.25 million EUR from TEN-E budget, while the MIBEL projects was financed by both the ERDF and the TEN-E budgets. 

12 Unfortunately information on the detailed shares of the European Commission budget injected into IBELM projects has been unavailable.
2.6.1 Cross-cutting issues on financial analysis

- The main issues about project financial analysis are cost overruns and revenue overestimation;

- Almost all projects in the sample experienced cost overruns. The main causes are delays in project implementation and opening, changes in project design and changes in environmental requirements. As far as revenue forecasts are concerned, their inaccuracy is due mainly to demand analysis overestimations (please refer to the previous section);

- Case studies where small or even no cost overruns occurred showed that adequate project management is one of the most effective tools to limit cost increase. Particularly a strong responsibility of the project manager in respect of implementation deadlines is helpful to avoid cost escalation.

- In France a full methodology for projects financial analysis is defined by the central planning authority of the country. Indeed, both French TGVs investments have been analysed using the national approach, which requires the calculation of a predetermined set of financial performance indicators, such as the financial internal rate of return and its reimbursement period. In addition, ex post financial assessment is mandatory by law and has to be carried out ten years after the opening of the new infrastructure. The methodology should be equal to the one used for the ex ante assessment to allow the identification of deviations and source of errors as well as to provide positive feedbacks on subsequent project implementation.

2.7 Economic analysis

In the evaluation of transport and energy project the most used approach for assessing costs and benefits is the Cost-Benefit Analysis (CBA), which analyses whether or not investing in a specific project and permits to assess project’s economic return, considering that alternative investments exist to achieve the same objectives.
2.7.1 Transport sector

Table 2.11 Features of the economic analysis by project

<table>
<thead>
<tr>
<th></th>
<th>Discount rate</th>
<th>Time horizon</th>
<th>Economic IRR</th>
<th>Economic NPV</th>
<th>Cost/Benefit ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterway Crossing</td>
<td>3%</td>
<td>6,6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magdeburg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oeresund Fixed Link</td>
<td>3%</td>
<td>279,626</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICE Frankfurt – Cologne</td>
<td>3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paris - Lille TGV</td>
<td>8%</td>
<td>20 y</td>
<td>20,30%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Lyon - Marseilles TGV</td>
<td>8%</td>
<td>20 y</td>
<td>11%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madrid - Seville AVE</td>
<td>6%</td>
<td>30 y</td>
<td>0%</td>
<td>- 3,211</td>
<td></td>
</tr>
<tr>
<td>Eurotunnel</td>
<td>30 y</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baltic Sea Motorway</td>
<td>3%</td>
<td>30 y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malpensa 2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors data processing

With the exception of the Malpensa project, for all cases within the EVATREN sample an ex ante Cost Benefit Analysis has been carried out. A full CBA analysis is available for three projects, namely the two French TGVs and the Eurotunnel. For the other five projects the sheets of the analyses are not available, however in some cases the methodologies used for the analysis have been reconstructed on the basis of the general national guidelines for appraisal. This is the case for the three German projects as well as for the Madrid Seville HST.

Table 2.12 Types of analysis used for the economic assessment of project

<table>
<thead>
<tr>
<th>Economic analysis</th>
<th>CBA</th>
<th>Spatial analysis</th>
<th>EIA</th>
<th>Regional Impact Assessment</th>
<th>Ex post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterway Crossing Magdeburg</td>
<td>X*</td>
<td>X</td>
<td>X</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Oeresund Fixed Link</td>
<td>X*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>ICE Frankfurt - Cologne</td>
<td>X*</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Paris - Lille TGV</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>Lyon - Marseilles TGV</td>
<td>X</td>
<td>X</td>
<td>X**</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Madrid - Seville AVE</td>
<td>X*</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>X°</td>
</tr>
<tr>
<td>Eurotunnel</td>
<td>X</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Baltic Sea Motorway</td>
<td>X*</td>
<td>X</td>
<td>X*</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Malpensa 2000</td>
<td>O</td>
<td>O</td>
<td>X</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Source: Our data processing

Legend: *Existing, but is not available; **Included in the CBA; ° Unofficial assessment.
As shown in Table 2.12 further methodologies have been used to assess socio economic impacts. In particular for Malpensa a regional impact assessment has been used for the economic performance of the project.

There is evidence that project nationality matters on the approach used for the analysis. The French TGVs as well as the three German projects have been analysed using respectively the French and German national guidelines. The French approach is strongly based on the Cost Benefit Analysis and in addition the specificities of the methodology are set out each time a Master Plan for the transport infrastructure is developed.

The approach in the two projects at hand is slightly different regarding the items to be included in the benefit and cost computation. Both methodologies ask for the computation of the economic internal rate of returns, which should be higher than a minimum threshold determined in the Master Plan.

The main change in the two methodologies has been the introduction of standard monetary values for external effects provided by the Ministry, which have been defined in the Boiteux report of 1993 (the document which explains the methodology for the CBA used in the evaluation of the Lyon-Marseille TGV). More specifically the report addressed the following topics:

- Time gained by passengers, with a value of time of 91F (approx 13.87 €) per hour
- Benefit for passengers diverted from air (considering cost and value of time of travel)
- Gains in Safety, decrease of pollution (220,000 T of CO), and reduction of congestion on roads.
- Losses for the state coming from variation of petroleum taxes and VAT.

The economic analysis for the Lyon-Marseille TGV was carried out implementing a Cost-Benefit Analysis, which followed the methodology made public in the Boiteux report of 1993:

- Gain of time amounted to almost 1,4 BF (approx 213 M€) per year compared to only,
- Safety was 95 MF (approx 14.5 M€)
- Advantages for passengers diverted from air amounted to 240 MF (approx 36.5 M€),
- Total costs for the society amounted to respectively 255 and 180 MF (approx 27.5 M€) per year.

The economic rate of return is estimated to 11% in 1994 (and 12.2% in 1990), which is 3 points higher than the recommended economic rate of return requested, by the “Commissariat au plan” at that time (8%).
It is very important to outline that in France an ex post analysis of the economic performances is mandatory by law (ten years after project opening). The Paris-Lille TGV has been re-assessed, while the Lyon-Marseille TGV ex post results will be available in 2010. Furthermore, the ex post assessment should be developed by using the same methodologies as for the ex ante appraisal allowing a consistent comparison among figures, deviations and creating positive feedbacks on the whole appraisal process.

The ex-post analysis of this project could be a difficult task, as in the meantime new projects have been planned and/or developed. This brought a deep change in the reference scenario as it was in 1990 and as it has been subsequently incorporated in the 1993 Boiteux report.

The Paris-Lille TGV case provides comparable figures for the ex ante and ex post assessment as the project was completed in 1993 and its ex-post analysis was published ten years afterwards\(^{13}\).

The project economic impact was assessed by a Cost Benefit Analysis. The ex ante economic analysis showed an economic internal rate of return of 20.3% on a 20 years time horizon and identified two main categories of stakeholders benefiting from the realisation of the project:

- the SNCF, that is the railway operator, for which a 12.9% economic internal rate of return was calculated;
- the users as they were supposed benefiting from a significant gain of time for the same price of transport.

Other groups of stakeholders such as motorway companies, air companies and the state were not expected to benefit from the project. More specifically they would have incurred in costs (losses of revenue, extra contribution for social tariff) amounting up to nearly 10% of the cumulated benefits of SNCF and the users.

Gains of safety amounted to about 2% of the total benefits.

The CBA focuses on the benefits and costs for the French agents (including gains of time in neighbouring countries). The railway companies\(^{14}\) agreed on sharing costs and revenues proportional to the distance travelled.

Project ex post economic rate of return estimated in 2005 (based on 2003 figures) was 5%. This value reflects the deterioration of the results of SNCF (see above in chapter 7 on financial analysis) that were not compensated by the gains for users since prices of travel have been much higher than expected, capturing users’ added value.

---

\(^{13}\) The project has been ex post evaluated 10 years after it started its operations as required by the French law: under this point of view TGV Nord is one of the first projects in rail domain (some already existed for motorways) to have in France an “ex post” analysis

\(^{14}\) The Paris-Lille is part of the PBKAL HST network
Furthermore, this rate suffers a reduction depending on demand fluctuations in projects, which are part of the same HST network (PBKAL – Paris, Brussels, Cologne, Amsterdam and London). More specifically the rate is partially sensitive to toll rates for the Channel Tunnel Eurostar (see also Chapter 4 on project dependency).

The three German projects constitute another homogenous group in terms of the methodology used for economic appraisal.

A macro-economic approach has to be applied to every infrastructure project, which asks for financial funding from the federal government budget. The economic analysis is based on a Cost-Benefit-Analysis, which has been significantly changed over time by improving methodology or including further parameters (e.g. CO₂). The aim of the economic analysis is to rank projects, which are competing for financial resources. Therefore, all projects under consideration had to fulfill the same methodology, which is dependent on general political objectives by defining parameters, and related values. CBA is implemented in order to obtain the benefit/cost ratio of the projects in order to rank the projects within the Master Plan (FTIP – Federal transport infrastructure investment program). The FTIP defines the B/C ratio thresholds under which project are not admitted to public financing (threshold is unknown during assessment process). In addition to this, a spatial analysis and an environmental impact assessment are required in order to complement the CBA picture with the potential effects of project on disparities and on the environment.

The German CBA methodology computes the following items:

- Investment costs,
- Transport costs (including operating and provision costs),
- Employment impacts,
- Spatial vantages,
- Benefits for international interchanges,
- Emissions,
- Changes in replacement and maintenance of the existing network.

The German Federal Transport Infrastructure Investment Plan does not prescribe any ex post analysis for verifying the results, which have been achieved by projects.
Box 2.2 Waterway Crossing Magdeburg

No ex ante has been obtained for the Magdeburg, but the Benefit/Cost ratio values for each one of the alternatives considered in the Options analysis have been provided.

Following this approach three different alternatives have been analysed with the objective to realise the most efficient project. Results of the assessment for the FTIP 1992 are summarised in Table 44.

Table 44: Results of the FTIP 1992 assessment for the three alternatives

<table>
<thead>
<tr>
<th>Benefit-Cost-Ratio</th>
<th>One-way bridge</th>
<th>Two-way bridge</th>
<th>Dam alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTIP 1992</td>
<td>6.6</td>
<td>6.3</td>
<td>6.2</td>
</tr>
</tbody>
</table>

Source: Planco 1992

It can be noticed that all three alternatives have a positive impact on the economy (ratio > 1). The best performing alternative is the one-way bridge with a ratio of 6.6, which has been recommended by the authors of the study for implementation (Planco, 1992).

Official results on the economic performance of the Waterway Crossing are not available. However looking at investments costs and demand recorded, it seems plausible that Benefit/Cost ratios were somehow ex ante overestimated.

In fact significant deviations occur for freight volumes (See chapter on demand analysis) and total investment costs for the investment project (See chapter on financial analysis) between forecasts and actual numbers.

EVATREN sample allows grouping the four HST projects. These projects showed very similar causes for deviations between ex ante and ex post assessment. These are:

1. Demand overestimation,
2. Underestimation of investment costs.

Both elements are relevant inputs for projects’ economic analysis and consequently economic performances are very sensitive upon them.

Regarding demand overestimation, the ex-post study from de Rus and Nombela (2005) on the Madrid-Seville HST is very helpful. The analysis gives the first year net benefits (demand related) required to reach a positive social net present value during the life of the project as well as the volume of demand needed to satisfy this condition.\(^\text{15}\)

\[^{15}\] This is based on the following equation:

\[
\frac{B(C) - C_e(Q)}{I} > \frac{r - \delta}{1 - e^{rt - \delta s}} + \frac{C_e r - \delta}{r(1 - e^{rt - \delta s})}
\]
Table 2.13 shows the results for different growth rate of net benefits during the life span of the project (40 years).

**Table 2. 13 First year net social benefits required for NPV=0**

<table>
<thead>
<tr>
<th></th>
<th>$\delta=2%$</th>
<th>$\delta=2.5%$</th>
<th>$\delta=3%$</th>
<th>$\delta=4%$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex post simulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In EUR (1993) Million</td>
<td>117</td>
<td>107</td>
<td>98.6</td>
<td>82.4</td>
</tr>
<tr>
<td>% of Investment costs</td>
<td>4.98</td>
<td>4.58</td>
<td>4.21</td>
<td>3.52</td>
</tr>
<tr>
<td>First year required demand*</td>
<td>15.9</td>
<td>14.7</td>
<td>13.4</td>
<td>11.3</td>
</tr>
<tr>
<td>In EUR (1993) Million</td>
<td>20.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of Investment costs</td>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First year actual demand*</td>
<td>2.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: de Rus and Nombela (2005)

Legend: $\delta$=growth of net benefits, fixed infrastructure maintenance costs not taken into account; *Million of passengers - generated traffic included.

Actual benefits generated in the first year counts for 17% of the needed benefits in the 2% scenario.

According to this ex-post study, the traffic volumes on High Speed Train (AVE) Madrid-Seville in its second year of operation were lower than expected (3.6 million passengers including short distance commuters) and a positive economic NPV over a 40 years time horizon would not be possible with these volumes.

Investment costs for the EVATREN cases, which have been analysed as a major cause for failure, show that all HST projects underestimated construction costs (see chapter on financial analysis table 20). These deviations lowered the economic performances of the projects.

### 2.7.2 Energy sector

No ex ante economic analysis of the projects in the sense of a Cost Benefit Analysis is available for both projects.

$B(Q)$ is the annual social benefit of the project, $C_q(Q)$ is the annual maintenance and operating cost variable with $Q$, $C_t$ is the annual fixed maintenance and operating cost, $I$ is the infrastructure construction cost; $T$ is the life of the project; $r$ is the social discount rate and $\delta$ is the annual growth of net benefits.

16 Net Benefits are calculated as follows: $B(C) - C(Q)$. 

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When evaluating the economic impact of the energy projects it is most likely to find analyses which try to identify if and to what extent energy market prices change with the implementation of new projects. The official versions of this kind of analysis are unavailable for both projects.

However some considerations on the topic can be made thanks to the simulation on price dynamics developed within the EVATREN research group. Such considerations are described in the appendix of the present chapter.

### 2.7.3 Cross-cutting issues on economic analysis

- CBA methodologies are country specific. France and Germany developed national approaches which are defined and updated by the national transport planning authorities;

- The German approach is based on CBA plus a spatial and an environmental analysis. Although CBA is the main methodology, used to rank projects and compute which of them is to be implemented, the other two appraisals may influence the ranking and/or define compensatory measures. The first stage of the appraisal consists of a CBA to compute the B/C ratio of every project in order to rank them. Projects with a B/C ratio higher than a certain threshold (fixed by the authority) will be realised, if the environmental as well as the spatial impacts do not have extraordinary effects;

- The French methodology asks for a CBA that should consider the whole external benefits and costs of the project. In particular values for monetising the external effects are provided directly by the central planning authority. The economic rate of return is calculated as the principal economic performance indicator. In addition, ex post analysis for each project is mandatory by law after ten years of operation. The methodology should be the same as for the ex ante analysis.

- The main causes for deviations between ex ante and ex post economic performances lie in the overestimation of demand as well as in the underestimation of investment costs;

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17 A cost benefit analysis was undertaken, according to (3EIng 2003b). However this analysis was not available from the DG-TREN. After discussion with TERNA, the cost benefit analysis was sent on 22nd May 2007. However, for confidentiality reasons, the results cannot be presented here.

In January 2005, time of commissioning of the San Fiorano – Robbia power line, the GRTN published a press release (GRTN 2005), including few expected economic benefits:

- increase of Italian import capacity by 1,100 MW, taking the total to 7,150 MW (+15%),

- progressive cost reduction for companies and for the residential sector, due to the price differential of electricity between Italy and neighbouring countries,

- increase of security of supply.
The overestimation of demand has been observed for most of the projects in the EVATREN sample. The influence has been particular comprehensive in the railway cases.

### 2.8 Environmental analysis

The analysis of environmental impacts mainly pertains to transport projects and should be a strategic part of their appraisal. In addition, in recent years the environmental issues are becoming more and more a concern for the public administration, both at national and at supranational level.

These issues could be assessed both from an economic point of view as well as from a more technical perspective. In the first case, it is advisable to consider project environment concerns within the economic assessment of the project. In the second case, it is arguable to provide an analysis that assesses how project design could be changed, in order to reach environmental benefits.

Table 2.14 Environmental analysis by project

<table>
<thead>
<tr>
<th>Analysis of environmental issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterway Crossing Magdeburg</td>
</tr>
<tr>
<td>Oeresund Fixed Link</td>
</tr>
<tr>
<td>ICE Frankfurt - Cologne</td>
</tr>
<tr>
<td>Paris – Lille TGV</td>
</tr>
<tr>
<td>Lyon - Marseilles TGV</td>
</tr>
<tr>
<td>Madrid - Seville AVE</td>
</tr>
<tr>
<td>Eurotunnel</td>
</tr>
<tr>
<td>Baltic Sea Motorway</td>
</tr>
<tr>
<td>Malpensa 2000</td>
</tr>
<tr>
<td>IBELM</td>
</tr>
<tr>
<td>San Fiorano - Robbia</td>
</tr>
</tbody>
</table>

Source: Our data processing.
Legend: *Included in the CBA; **Included in the options analysis

Seven projects in the sample treated the environmental issues in the appraisal process.

The German projects, the Oeresund, as well as Malpensa 2000 have undergone an environmental impact assessment following the national methodological requirements. The full documentation of the EIAs are not, however, available to the public.

Following Flyvbjerg (2003) the three “presumed deficiencies” of poorly effective Environmental Impact Assessments (EIA) are:
A lack of accuracy in impacts predictions;

The narrow scope of impacts and their time horizon;

And inadequate organisation, scheduling and institutional integration of the environmental impact assessment process in the overall decision-making process.

Looking at the EVATREN sample the last point demonstrated to be the most critical one. In fact the experiences of the Malpensa and the Oeresund demonstrated how crucial the timing of the EIA within the decision making process could be, in order to handle the environmental issue.

For Malpensa the environmental impacts have been a critical issue since the beginning of the project development due to the geographical location of the airport. However this did not avoid bearing some extra-costs, in terms of a containment of the night flights for acoustic reasons. This was due to the many different environmental analyses channelled to quantify statically what the impacts of the project could be, without formulating any viable solution or modifying project design or technical features.

Box 2.3 Malpensa EIAs – Many opinions, little effectiveness

The first environmental study was carried out together with the first Master Plan (Italairport, 1985), out of the EU framework that was implemented later into national normative (1988). This study has not been considered, since in 1986 the Regional Government required a new EIA, according to the European directive even if not yet implemented.

In February 1987 the first EIA is issued (Produzione Ambiente Risorse, 1987). This study can be considered incomplete, especially with regard to an underestimation of air traffic (12 Mpx), of the noise impacts and of the air pollution (Barzi et al., 2000).

Another ex-ante EIA (Battelle, 1997) has been carried out just before the airport opening. The Ministry of Environment advice about this study has not been positive, but a governmental decree approved it and the airport opened.

In June 1998 the Ministry of Environment required a third EIA. The study (SEA, 1999) is available after the airport is opened. Regione Lombardia and the Ministry of Environment produced two comments in October and November 1999. The Environment Ministry decree affirms, for the first time, that the forecasts were largely underestimated, mainly due to the effect of inclusion of Malpensa in the TEN-T network and the new role of “hub” of the airport, in the past never considered. One of the main prescriptions derived from this EIA concerns the noise limitation. A set of policies and funding has been applied to limit the effects for near villages. In particular, the airport operations were limited to a maximum of 63 movements per hour (Cranfield, 2000) and the shape of approaching routes has been optimised.

In conclusion it seems that the environmental issues haven’t been satisfactorily managed. For this reason they have been crucial, generating scarce acceptability of the project by the local populations. This opposition led to upsets and these partially modified the operative conditions of the airport, (limitation of daily flights number, of opening hours, of type of aircrafts allowed and of approaching routes) not allowing for a full exploitation of the airport potentialities.
On the other hand the Oeresund project incorporated environmental issues in the planning process from the beginning, but not in the sense of predicting impacts but to define appropriate environmental goals and then to set up the organisation that can effectively adapt and audit the project to achieve the goals in an ongoing process from project design through construction operation (Flyvbjerg, 2003).

Germany prescribes very detailed analyses beyond the Cost benefit analysis.

More specifically these are:

- A spatial analysis;
- An environmental analysis;
- A profitability analysis (for railway projects only);
- Further analyses, which can be demanded by the Ministry of Transport.

The results of the spatial and the environmental analysis are mostly qualitative and are not merged with the economic values. Therefore, three independent indicators are available for the decision maker. A good performance of the spatial or the environmental analysis can foster the decision for a special project whereas bad results can worsen or even reject projects. Nevertheless, the influence on the final decision is still mainly based on the economic result even though the importance especially of the environmental analysis increased over the last decade.

While in the 1980s spatial issues were only assessed for mega-infrastructure projects with displacement impacts in urban areas, nowadays every transport project undergoes such analysis. Impacts have to be expected on a corridor of 10 km on both sides of the infrastructure. The spatial analysis is carried out to privilege projects, which reduce disparities within Germany. Regions, which are under performing concerning labour market and general economic development, should be supported intensively. One possible lacking parameter might be transport infrastructure, which can be improved by privileging infrastructure projects in under performing regions.

Environmental impacts are analysed against humans, animals, plants, soil, water, air, climate, landscape, cultural assets and further assets have to be analysed. The methodological approach orients on an ecological risk analysis. For each of the parameters (e.g. bird population) a risk map has to be carried out which classifies the area under consideration in one of seven risk categories. The categories are defined from high risk to without any influence. The outcome of the EIA should lead to the definition of concrete compensation measures, which are very detailed and are Mandatory for the project.

Every railway infrastructure project has to be analysed on its operational profitability. This requirement derived from the guidelines of the Federal government to consolidate the German
Railway. The guidelines have been set up on November 23rd, 1983. The German Ministry of Transport could not provide the results of the profitability analysis.

In the description of the Transport Infrastructure Investment Plan 1985 the methodology has been explained very generally and no concrete criteria and parameter are given for the spatial and environmental analysis. Parameters should be defined individually concerning the concrete environment of each project under consideration. The following Federal Transport Infrastructure Plans (1992 and 2003) are more transparent about methodology and parameters used for the additional analyses (BMVBW, 1992 and 2003).

As said before the additional analyses of the German Transport Infrastructure Investment Plan have gained in importance over the past two decades with increasing awareness in environmental issues and with the German reunification on distributive issues\(^{18}\). In the beginning of the 1980s their standing has been less decisive for the decision-making than it is these days.

### 2.8.1 Cross-cutting issues on environmental analysis

- The environmental dimension is of major importance for all projects in the sample. In all analysed countries environmental assessments are mandatory but to very different extent;

- The main evidence is that the earlier the integration of the EIA in the design of transport projects, the stronger its influence on the final project designing. The case of the Oeresund is very meaningful as the environment analysis of the project was implemented at the very beginning of the process and thus it impacted strongly the final design. On the other hand the evidence from the Malpensa case study showed that when the EIA is fed too late into the project decision making process, it is very difficult to find effective and efficient technical solutions to avoid environmental costs;

### 2.9 Analysis of uncertainties

Involving forecasts for the future, projects are affected by a risk component which could lead to strong deviations from the ex ante forecasts. The role of a risk analysis is to identify the most important variables, and to quantify their potential impact. “Approaching risk analysis with a thorough methodology is essential in order to curb what is generally been the ‘appraisal optimism’ and to give decision makers a more realistic view of the likely outcome of projects, instead of incomplete and misleading view which do not inform of possible downsides of a project” (Flyvbjerg 2003). In addition, identified risk factors could be the starting point for the implementation of some suitable risk management strategies to deal with uncertainty and risk.

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\(^{18}\) Regional economic distinctions within Germany increased significantly with the reunification. It has resulted in an increasing reputation of the spatial analysis in the framework of the German Federal Transport Infrastructure Plan.
Regarding electric energy projects, the analysis of uncertainties is to be intended as the security criteria analysis aimed at ensuring that a power system is always operated in such a way that no credible contingency could trigger cascading outages or another form of instability. This kind of analysis, available for both the energy cases of the EVATREN sample, is presented as appendix to the following chapter.

Four projects included an analysis of the uncertainties in their appraisals (Table 15). These analyses are mainly limited to sensitivity testing of project outcomes. In two cases (Oeresund and Magdeburg) the construction of some “optimistic” and/or “pessimistic” scenarios has been carried out. In no cases a probability analysis has been implemented.

Following Flyvbjerg (2003), the sensitivity analysis of the effects on project viability of hypothetical changes in, e.g. construction costs, interest rates and revenues, is the most common techniques for analysing risk in transport project appraisal. However, the simple identification of the possible values that costs, rates and benefits may assume is not enough to develop a “proper” risk analysis, because a probability distribution is also to be considered to adjust such values. On the other hand it is rare that identifying alternative future states of costs makes risk analysis, revenues and effects and a probability distribution estimated for the likelihood that these states would actually occur.

Table 2.15 Analysis of uncertainties – Variables investigated and analysis features

<table>
<thead>
<tr>
<th>Investigated variables</th>
<th>Investigated outcome</th>
<th>Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delays</td>
<td>Investment costs</td>
<td>Transport demand</td>
</tr>
<tr>
<td>Magdeburg Waterway Cross</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Oeresund Fixed Link</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Lyon - Marseilles TGV</td>
<td>X</td>
<td>X*</td>
</tr>
<tr>
<td>Paris - Lille TGV</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Source: Our data processing.

Legend: *Consideration of GDP to assess the mobility rate; ^Joint variation of investment costs and demand; °Joint variations of demand and interest rates

Sensitivity analyses in the sample concentrate mainly on (see Table 2.15):

- delays in construction time,
- investment costs,
- transport demand,
- interest rates,
In the case of the Lyon-Marseille HST, project financial and economic performances have been analysed in relation to:

- GDP for mobility rate
- “tariffs” mainly as regards air competition

As pointed out above (See chapter 6 on demand analysis and financial analysis) competition is one of the most crucial issues in transportation and could have a strong influence on the project financial and economic outcomes.

In addition the methodology used for the analysis takes into account the effects that changes in selected variables would have on total demand. More specifically there have been efforts to include dynamic effects between competing transport modes in the model.

The GDP growth rate has an impact on mobility growth with elasticities close to 1, but it has an impact on air traffic with an elasticity estimated to 1.64. Therefore, GDP influences directly as well as indirectly (through diverted traffic) the HST demand.

Different values of GDP have been tested between 2.3 % and 2.8 %. With such hypotheses the volume of air traffic would be between 8.6 million and 10 million passengers.

Table 2.16 Sensitivity on air tariffs

<table>
<thead>
<tr>
<th>Decrease of tariffs in air sector till the 2000 %variances</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10%</td>
<td>6.8%</td>
</tr>
<tr>
<td>-20%</td>
<td>6.4%</td>
</tr>
<tr>
<td>-30%</td>
<td>5.8%</td>
</tr>
</tbody>
</table>

Source: our data processing

Sensitivity of the financial internal rate of return of the project on air tariffs is shown in Table 2.16. A reduction of 20% in airfares was considered as very plausible by the commission of experts in 1995, thus implying a reduction of the rate of return to 6.4% for SNCF.

In conclusion of the sensitivity analysis it appeared that the Internal Rate of Return (IRR) drop by 0.5 or 1%, and contemporarily that the internal rate of return does not fall under 6%, since most of the benefits from SNCF was coming from the transfer of existing travellers to the new line.

Regarding the socio economic evaluation it was noticed that even with:

- an increase of 20% of the investments costs;
• a reduction of 25% of airfares;
• and a reduction of 20% of the SNCF benefits (in addition to the decrease of air fares);
the socio economic rate of return would still be higher than 8% (which was the minimum economic threshold for project implementation) and therefore a very stable positive result has been assessed for society.

A critical review on the sensitivity analysis in the light of the actual development in the air sector market shows that the analysis of tariff sensitivity still remained too optimistic for SNCF. Analyses based on average tariffs (or average revenues) are obviously not sufficient as the “yield management” policies implemented by SNCF and air companies will demonstrate that the range of tariffs have been much larger than the hypothesis considered. The competition between air and the Marseille-Lyon HST line should have been of even stronger concern because both modes compete for long-distance passengers.

Another point raised by the Lyon-Marseille TGV is on the sensitivity of the fuel price, which has not been considered. It is true that the model could not include such variable but this is not an excuse for not considering it at all which definitively could have strong consequence on traveller behaviour and model choice.

Conversely to the Lyon-Marseille TGV, the Oeresund risk analysis focused on financial aspects and aims at determining the investment repayment period when interest rates on the debt as well as traffic on the link change.

Sensitivity analysis for the two remaining projects (The Waterway Crossing Magdeburg and the Paris-Lille TGV) concentrated on economic figures:

• the Benefit-Cost Ratio for the Waterway Cross Magdeburg;
• the Economic internal rate of return for the Paris-Lille HST.

For the former it has been analysed how the overall performance of the investment reacts with changes in the input factors. As main input factors the parameters investment costs, duration of construction and demand (only in FTIP 1995) have been analysed.

The sensitivity analysis for the Waterway Crossing shows that the influence of the considered parameters on the final results is significantly. Especially investment costs play an important role on the final result of the economic analysis. Therefore, it is very useful to consider beside the absolute values of the economic analysis also its sensitivities.

However the actual figures for the Waterway Crossing (see chapters on demand and financial analysis) show that the sensitivity analysis should have been more critical about its worst-case scenario. For the Waterway Crossing the worst case scenario has been defined as plus 20% of investment costs and minus 20% of freight volumes. The actual cost overrun was around 18% (See chapter on financial analysis), while the traffic projections for 2010 (based on 2004 and 2005 figures) lead to minus 21% compared to the forecasts. It seems that the project already
reached its worst-case performance five years before the final date. Potential ranges for further deterioration of variables and project outcome are still possible, but were not considered at project appraisal.

Uncertainty analysis of the Paris-Lille TGV has only been carried out to a limited extent because the implementation of the project has never been contested. In addition costs were not considered as excessive and new “connex” projects have been added during the preparation and construction phase. Only the route choice through Amiens or Lille has stimulated some confrontations. Few tests to assess how the project would react to changes in the most sensible variables have been carried out. More specifically the economic performance of the project was tested for a 10% increase in the cost of infrastructure and a 10% reduction in the expected traffic. However changes of this size would have not endangered the profitability of 12.9% in economic terms.

Regarding the other five projects in the EVATREN sample it has to be noted that they faced a certain level of uncertainties during their implementation as well as operative phases even if no assessment of uncertainties or risk effects have been carried out.

More specifically, evidence on German projects pointed out the possibility that the force of various citizens’ initiatives, which try to avoid the infrastructure in their region, could pose a certain level of risk on project implementation. In fact these kinds of initiatives develop legal claims, holding up project implementation for several years. This causes delays making costs rising beyond expectations.

Finally another risk is the possibility that some exogenous shocks affect the project performance. Such events can be wars, oil shocks or terrorist attacks. These shocks affect the economy as a whole or an entire sector reducing demand and the financial performance. These events are very difficult to predict and also to manage as they are out of the scope of action of the project manager or operator. Nevertheless, the point is on project resilience to these events. For example Malpensa has been affected by several unpredictable events, which could have influenced its development positively or negatively (i.e. explosion in air traffic demand, the increase of cargo traffic, 11th September, etc). Such events have underlined a good level of project resilience since the airport has successfully managed the different market trends without compromising its successful performance.

Following the analysis of Malpensa it can be observed that all the ex-ante studies did not provide any analysis of uncertainty. The air transport activity in its whole is in fact strictly dependent on the overall economy, in particular price of oil, economic development, level of consumption and welfare, project environmental acceptability etc.

One issue is discussed in official studies, the transfer of the majority of flights from the Linate airport to Malpensa, which has been included in the “Burlando” decrees. Odoni (1993) defined it as difficult and occasionally controversial and underlined the necessity that SEA, the company that manages the airport, should formulate carefully a strategy for managing this process effectively. Another official document dealing with possible risks is Centro Studi PIM (1993). It
states that at the moment of including Malpensa in the Essen list, the most relevant issues of Malpensa were raised and public. The study pointed out that the market positioning of Malpensa 2000 is dependent on:

- The will and real feasibility that Alitalia, the flag carrier, is able to operate with a double-hub scheme, flanking Malpensa to Fiumicino\(^{19}\),
- The choice of franchisee to help the setting in Malpensa of the European hub of one non-European carrier (North American or Asian),
- The choice of the flag carrier, or of its shareholders, to tolerate a competitor in Malpensa or to establish a synergy following a “shared” model.
- The effects that the liberalization of European air transport will produce full application.

Despite the evidence of such risks in 1993 they have been considered neither in a formal analysis nor in public documents. The tools of risk or scenario analysis did not provide any help to minimise possible negative effects.

### 2.9.1 Cross-cutting issues on uncertainties analysis

- The analysis of uncertainties is not a common practice as only four out of eleven projects in the sample provided a risk assessment.
- Project uncertainties have mainly been analysed through sensitivity analyses and only in two cases using scenario analyses. In no cases a risk analysis has been developed;
- The analysis of the uncertainties mainly concentrates on a project’s economic performance and neglects the financial performance.
- The analysed variables are usually: implementation delays, investment costs, demand and tariffs. Variations range from ±30% to ±20% and proved to be too narrow and not realistic in the light of projects’ actual data.

### 2.9.2 Regional economic impact assessment

Regional economic impact assessment evaluates the potential economic impacts of a project for the surrounding regions. This kind of analysis focuses on economic indicators and forecasts the influence of the project on these indicators. In particular the assessment investigates how

\[^{19}\text{At the moment of the final draft of this document (October 2007), Alitalia issued the new industrial plan, meaningfully named “survival/transition”, whose main point is the at least temporary abandon of Malpensa hub due to severe financial problems. For this reason, the issue is still in evolution.}\]
changes in regional mobility and accessibility could redefine regional spatial modifications, economic actors’ behaviours and their physical relocation.

Extensive regional economic impact analyses have been carried out for the Malpensa and the Oeresund projects.

The main difference is that the regional analysis was the only type of economic assessment carried out for the Malpensa project, while the latter also underwent a CBA\textsuperscript{20}.

A CBA has never been carried out for Malpensa 2000. During the building phase, an analysis of the macroeconomic effects of the airport has been fed (Gruppo CLAS, LIUC_CRMT, CERTeT, 1995). This analysis was focused on assessing the regional economic development generated by the project.

According to this study three types of impacts on two different scenarios (2005 and 2010) have been measured to assess the overall economic impacts of the infrastructure:

- Direct impacts, corresponding to the economic effects generated by activities that provide services to passenger and freight.
- Indirect impacts, corresponding to economic effects generated by economic activities located off-airport but linked to it and that provide services to the infrastructure users.
- Induced impacts, deriving from the multiplier effects of direct and indirect impacts.

The study analysed three economic indicators: employment, output (turnover) and added value (Table 2.17).

\textsuperscript{20} An economic analysis in form of a Cost-Benefit-Analysis is Mandatory for every transport infrastructure project in Sweden and in Denmark since 2003, but this documentation is not available. A consortium of the Technical University of Denmark at Lyngby is currently working to assess the impacts of the Oeresund fixed link after more than six years of operation. The work should have been finished by end of 2006 but have not been publicized yet.
Table 2. Estimated economic impacts of Malpensa airport

<table>
<thead>
<tr>
<th>Types of impact</th>
<th>Employers (Units)</th>
<th>Output (£ million '93)</th>
<th>Added Value (£ million '93)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base scenario (1994)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON Airport activation</td>
<td>10,093</td>
<td>1,417</td>
<td>961</td>
</tr>
<tr>
<td>OFF Airport activation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>activities provided to the airport system</td>
<td>15,430</td>
<td>1,774</td>
<td>962</td>
</tr>
<tr>
<td>Indirect activation</td>
<td>7,913</td>
<td>1,336</td>
<td>622</td>
</tr>
<tr>
<td>Activation from the project circuit</td>
<td>17,885</td>
<td>2,653</td>
<td>1,383</td>
</tr>
<tr>
<td>Total activation</td>
<td>51,321</td>
<td>7,180</td>
<td>3,928</td>
</tr>
<tr>
<td>Middle term scenario (2005)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON Airport activation</td>
<td>14,472</td>
<td>2,053</td>
<td>1,373</td>
</tr>
<tr>
<td>OFF Airport activation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>activities provided to the airport system</td>
<td>35,430</td>
<td>4,081</td>
<td>2,228</td>
</tr>
<tr>
<td>Indirect activation</td>
<td>15,867</td>
<td>2,666</td>
<td>1,259</td>
</tr>
<tr>
<td>Activation from the project circuit</td>
<td>34,149</td>
<td>5,066</td>
<td>2,641</td>
</tr>
<tr>
<td>Total activation</td>
<td>99,918</td>
<td>13,866</td>
<td>7,501</td>
</tr>
<tr>
<td>Long term scenario (2015)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON Airport activation</td>
<td>20,204</td>
<td>3,246</td>
<td>2,230</td>
</tr>
<tr>
<td>OFF Airport activation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>activities provided to the airport system</td>
<td>51,179</td>
<td>5,899</td>
<td>3,225</td>
</tr>
<tr>
<td>Indirect activation</td>
<td>23,214</td>
<td>3,883</td>
<td>1,837</td>
</tr>
<tr>
<td>Activation from the project circuit</td>
<td>51,231</td>
<td>7,601</td>
<td>3,962</td>
</tr>
<tr>
<td>Total activation</td>
<td>145,828</td>
<td>20,629</td>
<td>11,254</td>
</tr>
</tbody>
</table>

Source: Gruppo CLAS, LIUC-CRMT, CERTeT (1995)

For the Malpensa project also an ex post assessment of its economic impacts has been carried out (see Box below) six years after its opening (2004). The Milan and Varese Chamber of Commerce requested the study to the same research group.

According to this ex post analysis (LIUC, 2000 and 2004) the overall economic effects of the airport on the regional development are lower than the forecasts for the middle term horizon.
The study supposes that this is due to a delay in expectations rather than an overestimation of the effects, because the main factors that limited such impact are not directly attributable to the airport performance, but have an external nature. First, the lacking of a logistics hub in the area around the airport has considerably influenced the airport economic impact. Such an infrastructure would have stimulated the settlement of new firms around the logistics hub that would have boosted the regional economic development. Second, the scarce development of the surface access network may have heavily slowed down the potential impacts of the infrastructure. Even if the direct surface access has been realized the airport is still not integrated into the local road and rail network. Third, the Cargo City around Malpensa shows inefficiencies that make the use of other airports for freight preferable. All these factors reduced the forecasts for the regional economic impacts of the project but also show that the airport still has potentialities that are not yet expressed.

Box 2.4 Ex post analysis of the Malpensa economic impacts

In order to carry out such evaluation, the historical series of some indicators have been analysed: Added value; Pro capta added value; Employment rate; Unemployment rate; Evolution in the number of firms and firms nativity rate; Foreign trade (import/export).

Results give no evidence of an economic development speeding up as consequence of the airport presence. According to this analysis some positive impacts on the regional economic development are more evident in the period before the airport opening (from 1995 to 1999). In these four years the growth rate of the selected indicators are higher than the values recorded in the following four year of the time horizon (from 1999 to 2002). Such evidence underlines the presence of many expectations related to the airport opening that have been quite failed. Moreover, the trend shown in the first four years is a clear signal of a “building phase effect”.

During the period going from 1995 to 2002, the Italian economic system has recorded a general negative performance. In the analysed area, the effects of the recession which affected the national economy seems to be partially absorbed by the positive impacts generated by the airport opening. Except the city of Como, whose economy has greatly suffered for the crisis of the textile industry, all the cities in the area have recorded economic results that are not lower than the Italian average.

The microeconomic impacts, which have been investigated, are related to the strategic choices of the firms. The relation between the airport presence and firm localization is the investigated element.

According to the theory of economic actors behaving with rationality, the presence of an efficient infrastructure endowment should play a key role in the strategic choices of a firm. In particular, the presence of an airport hub is supposed to be a key element in the localisation choices of the international companies. However, even if the air accessibility is a fundamental factor in the localization issue and the airport presence greatly increases such accessibility, this is just a necessary but not a sufficient condition.

In order to be a sort of “tool” for the firm economic activity, an efficient airport surface accessibility is required. By now the airport surface accessibility is still a critical point and its scarce development level is supposed to be a relevant limit for the potential economic impact of the airport infrastructure.
Beyond a Cost Benefit Analysis\footnote{An economic analysis in form of a Cost-Benefit-Analysis is Mandatory for every transport infrastructure project in Sweden and in Denmark since 2003, but this documentation is not available. A consortium of the Technical University of Denmark at Lyngby is currently working to assess the impacts of the Öresund fixed link after more than six years of operation. The work should have been finished by end of 2006 but have not been publicized yet.}, the economic impact of the Öresund fixed link was evaluated by a regional economic impact analysis. The impacts for the region as a whole have been a major driver for the fixed link as it was built with the objective of strengthening the economic and cultural ties between Denmark and Sweden.

The impacts of the link on the region as well as vice versa have been assessed for the following parameters:

- Labour market,
- Housing market and
- Economic benefits.

Before project implementation, the Öresundbro Konsortiet defined the possible impacts of the link at regional level as follows (Öresundbro, 2007):

- A unified labour market can create a balance between the relatively high level of unemployment in Skane (Sweden) and the acute demand for labour in Denmark (especially Copenhagen),
- A common housing market can relieve the overheated housing market in the Copenhagen area whereas housing in Skane is more reasonably priced and capacities are available,
- Creation in the Öresund Region of a domestic market comprising 3.6 million consumers and 220,000 Danish and Swedish companies.

Comparisons in the economic impact assessment between Malpensa and the Öresund show that for the Malpensa case no references to specific objectives of the project have been made. Conversely the Öresund assessment started from the declared objectives of the two nations, namely Sweden and Denmark, to develop a uniform economic and cultural area around the Öresund. In addition a CBA has been applied to analyse if the project is worth the investment costs. The Malpensa approach focused on the benefits for the region without taking into account the investment costs for the region.
2.9.3 Cross-cutting issues on regional economic impact assessment

- Two projects show a regional economic impact analysis. In one case (Malpensa) the regional economic impact analysis has been the only analysis on which the financing decision was based. For both cases, however, the analysis tries to assess the effects of projects implementation on some macro-economic indicators.

- In all other projects the regional economic impact assessment is missing.
3 Methodological developments

The objective of Workpackage 3 has been to identify areas where the ex-ante analysis failed (e.g. over/under evaluating direct or indirect impacts, missing dynamic phenomena, etc.) and propose improvements to appraisal methodology and decision tool.

The first step of Workpackage 3 has been to provide an “horizontal analysis” more independent from case studies than what already done in Workpackage 2 and oriented toward EU needs to improve evaluation methods of large infrastructure projects of EU interest and to define, at the end, the EU guidelines for ex-post analysis. This “horizontal analysis” has been summarised in a grid of problems and solutions, which has been the basis for the re-examination of case studies in order to verify their effectiveness in increasing the capability of the projects in achieving their identified goals.

Work carried out in this third Workpackage is therefore of different nature with respect to what has been completed in the previous case study analysis, which was conducted within a framework that was predominantly a national one, even though related to an international context, since most of them were or “became” (in the case of the oldest ones) part of TEN networks. It has mainly consisted in pointing out major themes of relevance concerning an evaluation process from the EU point of view, with particular attention to the positive contribution of ex post evaluation to the overall assessment process.

3.1 Results from the case studies re- examinations

First task of work package 3 was to identify some lines of investigation to be then confirmed or rejected through the re examination of case studies.

The starting point for the lines of investigation were the conclusions derived from the case studies ex-post examination. The selection of the lines of investigation was completed by linking the weaknesses identified through the analysis of the case studies to the corresponding possible solutions, focusing on those weaknesses and those areas of improvements that are particularly relevant for large infrastructural investments projects in the Trans European Networks.

The re examination of case studies moved along the following lines of investigation:

- European dimension and segmentation
- EU policy objectives
- European scenarios
- The definition of a common evaluation methodology
• Incompleteness of the analysis

• Continuity and transparency of decision process.

3.1.1 The European dimension and segmentation

The importance of European dimension concerns European networks development, international transport services and operations, evolution of transport regulation that nowadays defined at European level for long distance freight and passenger transport. This component is in most of the cases the most dynamic component of the transport demand due to European integration and enlargement, facilitated cross border operations and interoperability between national networks and development of European transport services.

For the majority of the project considered the evaluation process was conducted from a national point of view, the European dimension was introduced rather late in the project history, and the policy and regulatory framework was significantly different from the current one. Bilateral and transit flows were not appraised in the same way than national traffic, with very general considerations about demand originated and destined abroad. The consequence was a biased understanding of transport evolution, and a lack of harmonisation with neighbouring countries administration for assessment of bilateral or transit traffic.

International and European aspects are mentioned in most of national projects, but often treated essentially as a “political” issue, rather than a concrete demonstration of the impact of European trade on transport evolution. Several topics can be considered to show such a situation:

• Interdependence between national and European transport not properly taken into account.

• A problem of data - and also of proper segmentation - of the transport market;

• National specificities and institutional contexts.

3.1.2.1 Inclusion of supra-national dimension

The European transport network is a combination of modal networks within which there are hierarchies such as national, regional and local roads. Therefore there can be conflicts between local and global optimisation within modes, between modes and between countries (Laird, Nellthorp, Mackie, 2005). If the analysis is carried out only at the national level there is the risk that the network effects occurring within the international transport market are not properly considered. To some extent the problem is similar to the misspecification of the study area (Laird, Nellthorp, Mackie, 2005) Also in this case the implication can be significant, the exclusion of part of the network or of some flows, can either underestimate or overestimate the economic impact of a project. This is quite evident in many of the case studies considered.
TGV Paris – North The HST Paris - Lille has been conceived, from the beginning, assuming only the construction of the Channel Tunnel. Very rapidly the project became European with the extension to Belgium, Germany and Netherlands, but all the evaluations were done at national level. The coordination of the whole project, at the international level was not very strong: the consultation process between representatives of the countries involved in the project seemed take place only before the launching of the project. Demand forecasts also suffered for lack of a European perspective. When the decision to proceed was taken, railways companies had already undertaken their own studies on their national network. Therefore, the linkage with the UK context was weak as the analysis did not take in consideration the reactions of ferry companies and their still important market share on the Channel Tunnel.

A20 – Baltic Sea Motorway The context analysis of the project took into account the most evident political and economic developments at stake. Nevertheless, the trend of globalisation and the fast growing trans-continental trade flows were not taken into consideration thoroughly. A more intense consideration of mega-trend could possibly have lead to a different location of the motorway closer to the Baltic sea coast, improving port access and helping to solve current capacity shortage in port hinterland traffic.

Malpensa Airport The Malpensa project rose from a regional and national context. The European dimension was introduced much later. This fact heavily influenced all the preliminary aspects of the process. In particular: the project objectives, the decision-making process, the context analysis, the option and economic analysis.

Madrid-Sevilla AVE The ex-ante analysis underestimated the share of international travellers and the combined air-train trips using the Madrid-Barajas airport as a hub. Since no low-cost air travel was available at the time of the ex-ante analysis, the important development of air transport in Spain and its interaction with AVE was missed.

3.1.2.2 Lack of reliable EU data and demand segmentation

It should be reminded that at the time when the feasibility studies of the majority of the project considered were completed (the eighties and early nineties) the international flows were at that time much lower, the opening of the internal market and the further enlargement of the EU countries have significantly contributed in increasing the international trade and flows within the EU. Many of the information now available were at the time the ex ante studies were carried out simply not available, the case studies cannot, therefore, directly show the distortion due to the lack of EU data. But they can highlight the importance of this dimension for future projects. Lack of data is also matter of proper demand segmentation. This is a limitation of both available data (at least at that time) and of the methodology used for demand forecasts. Some examples of the relevance of this issue for the case studies analysed are provided below.
Eurotunnel  Much of the structural changes in traffic pattern and customer behaviours could not be properly taken into account. Most of the information was obtained from former studies using trend analysis. Although the observed past trends were revised for projection, this technique produced an important discrepancies with actual demand observed later, for the evolution of the global market in particular. Concerning the segmentation of the market, in the cross Channel market, coaches took, at that time, a very important market share, which has considerably reduced since then with use of air or personal cars. Therefore the evolution of leisure trips, which are the majority of trips, was probably not appraised sufficiently in terms of “way of life” evolution, leisure time, choice of destination, which have also influenced the choice of mode independently of the evolution of the air transport supply (with development of low cost).  

For freight the problem was probably more competition between routes using ports of Channel and ports of Northern Sea: therefore the market segmentation would have certainly required detailed O/D analyses with routes performances comparison.  

Madrid-Sevilla AVE  The analysis of demand was based on an extrapolation of past trends in traffic on the existing corridor and no specific analysis of other related O-D flows was carried out. The segmentation of passenger demand was very limited and did not include market segments like business travellers or tourists that proved to be an important part of overall demand. No specific analysis of competition with road and air was carried out.  

Malpensa Airport  The airport was conceived to become the main Northern Italian airport and hub between domestic/continental flights and continental/intercontinental destinations. For this reason, the scale of the flows is typically European and not only Italian. The availability of standard estimations and projections of O/D European flows would have constituted a much more robust data base, or, at least, a more transparent input for demand analysis. Instead, the airport designers used some own forecasts that resulted to be underestimated.  

3.1.2.3 National specificities and institutional context  

There are two interesting outcomes of the case studies re-examination that should be mentioned. On the one side, the attempt to homogenise the analysis, in particular the economic analysis, for those projects involving several countries. On the other side, the high degree of specificity of the decisional processes in the different countries. Most European countries have official economic assessment methodologies to support decision making process, but the approaches appear very heterogeneous across Europe. Accordingly, the outcomes are hardly comparable (especially for cross-border projects) and a ranking of European projects competing for public funds is impossible.
The Eurotunnel project was from the beginning more a “bi national” project than a European project. At the bi-national level efforts were certainly made in order to go beyond national specificities and to have agreement on common appraisal for traffic and project evaluation. But these efforts had limited success because, at the same time, the project was supposed to become a “private” initiative project without public intervention.

Madrid-Sevilla AVE Although one of the starting points of the construction of the AVE network was the need to develop a standard European gauge network in Spain and connect to the French TGV network, only the technical issues of connecting to a European network were taken into account.

Öresund fixed link The challenge of the economic assessment of the Öresund fixed link was that two countries with two independent assessment methodologies were involved in the planning, design and assessment procedure. Both countries have different guidelines and use different approaches. The chosen procedure of Sweden and Denmark to unify their national methodologies (at least for the Öresund fixed link assessment) could become a precursor for a unified European approach. Recommendations on an harmonised approach have already been developed by the EU funded research project called Heatco (Heatco, 2006).

Also the electricity connection project between San Fiorano (IT) and Robbia (CH) was clearly strongly affected by national specificities. These had a major impact on the decision-making process, for which almost only local and national institutions were involved in the project decision.

3.1.2 The importance of the EU policy dimension

The policy dimension is the framework for the objectives to be reached in the implementation of the project. The national policy dimension is in general privileged when it comes down to cost and benefit evaluation. But the policy dimension of a project is also more and more often a European policy dimension with concrete objectives relative to modal shift, environmental impact, as well as a regional policy dimension when regional accessibility and development is concerned. The consideration of all these objectives is a prerequisite for a proper co-financing of a project by different public authorities as well as for social acceptability. In many case studies the absence of regional objectives has made more difficult the project implementation and the absence of European objectives has often biased the traffic assessment.

“Interoperability”, “intermodality” of transport systems and more generally “governance”, “subsidiarity”, “sustainability” principles are today among the EU concepts that are relevant for the projects evaluation. But evaluations of the projects analysed were often conducted at a time when the EU transport policy objectives were not so clearly formulated as they are today. In particular, the promotion of intermodal transport was not an issue in the planning process, as for instance is apparent in the case of the A20 – Baltic Sea Motorway where connections to ports or

railway transhipment terminals were out of the scope of the planning process and Trans-European travel alternatives were not considered. Even the consideration of the regulatory context was too limited in many cases (the competition with low cost companies due to the “open skies” policy, the increase of the cost of the rail ticket, the toll of the Channel tunnel due to the use of the network). These factors led to inaccuracies in the demand forecasts negatively affecting the return on investments.

Madrid-Sevilla AVE The railroad network was dealt with in isolation from both the road and air network. This lack of analysis of intermodality has probably led to a less than optimum design of the Madrid-Sevilla AVE link and the whole Spanish railway network in general. Governance and subsidiarity were neither issues included in the analysis (at the time Spain was also changing the division of competences between regions and the central government) and are points that are still causing conflicts in decision-making for the AVE network design today. Again many operational issues were left out of the analysis. The main elements considered were time, cost and comfort, but efficiency or security issues were not part of the impact assessment. Neither did the analysis foresee any changes in the regulatory context.

TGV Paris – North In the 80th the European transport policy was under construction, but TGV North HST line, which connected 4 countries, had to face up problems of interoperability between rail systems which were not harmonised (different signal systems, different electric power..). The competition with other modes was only envisaged as a market share to be taken by the new line on the road, the air and ferries which cross the Channel. Ex post analysis shows that other aspects of intermodal and interoperability policies (which have appeared afterwards as fairly successful) could have introduced more explicitly. Some important regulation elements were missed in the demand estimation and the economic analysis. Namely the competition with low cost air companies due to the “open skies” policy initiated by the European Commission.

TGV Mediterranean The context of competition with air was certainly more directly taken into account in the HST Mediterranean case study as well as regulatory context concerning application of norms for operations and protection of environment. From this point of view there is an intermodal scope and a good consideration of regulatory context in the TGV Mediterranean evaluation process. Operation performances for HST services have been a point discussed in project evaluation with introduction of European techniques related to HST interoperability and expected development of Command Control System (ERTMS). From the technical point of view control command of HST Mediterranean was a new step in use of new technologies and application of European norms.

Öresund fixed link The main focus of the infrastructure investment was on a local/regional level (e.g. improved access to markets). Therefore, EU transport policy objectives played a minor role even though the link extends the St-Petersburg–Helsinki–Stockholm-Copenhagen transport corridor to Central and Southern Europe. During the 1990s when the fixed link was finally planned and constructed, transport policy was mainly related to national infrastructure objectives and programmes. The same holds for the investment of the Öresund fixed link where the focus has been placed on national/regional objectives (housing markets, access to surrounding markets, labour market, etc.).
A20 – Baltic Sea Motorway EU transport policy objectives were not taken into account thoroughly. Insofar the rail alternative was not considered, respective network effects on European level have not been looked at. This omission does not primarily touch on the competition between the modes, but on their complementariness: the later introduced concept of “motorways of the sea” (MOS) and the promotion of intermodal transport was not an issue in the planning process. Connections to ports or railway transhipment terminals were out of the scope of the planning process and alternative Trans-European travel alternatives were not part of the options analysis. But at that time the EU transport objectives were insufficiently clear.

Malpensa Airport The regulatory context was completely missing at the moment of decision. At the moment of inclusion into TENs (1994), the third liberalisation package was issued, allowing the continental “open skies”. This evolution, together with the strict regulation of public help to industry, changed completely the frame of the sector. The consideration of these issues would have positively influenced the decision making, the option analysis (evidencing the fragility of the market scenario assumed) and especially the demand estimation (both evidencing that demand was higher than expected, but also the powerful competition of other airports and airlines).

3.1.3 Formulation of socio-economic scenarios

Socio-economic variables are key drivers of transport demand, so that their identification is a prerequisite for correct demand forecasts. In many of the projects considered (Eurotunnel, TGV Paris – North, Malpensa, High - Speed - Rail – Connection- Cologne - Rhine/Main) future demand scenarios, at least for international traffic, were not enough detailed, and as a consequence demand estimate were inaccurate and this has negatively affected all the other parts of the planning process, namely options, economic- and financial analyses. Additionally, as far as European factors are concerned, scenarios should be consistent while in the analysed project independent assumptions were made. In general, the formulation of a common EU reference scenario on economic development and transport demand could have helped decision makers in two respects. First, the future intra-European transport flows should have been considered also from a European perspective. And second, different transport infrastructure projects would have been made comparable on the basis of the same assumptions at least from the point of view of international flows.

Eurotunnel The reference socio economic scenario was just a trend scenario. High and low hypotheses were also explored, however this was not sufficient for long term analysis and structural changes. The stake behind was an integration of UK economy within Common Market, which was expected to be an important step in the development of EU. International transport context could have been explored more in detail concerning performances of routes, strategies of operators, including maritime operators. During the construction, when it clearly appeared that ferry companies were heavily investing in order to prepare for competition, no updating of the market competition conditions has been done. In the same way it was difficult to have discussions between rail companies promoting of HST, and airlines companies.
Madrid-Sevilla AVE  The transport demand scenarios used in the ex-ante analysis consisted of a baseline projection of traffic with alternative scenarios dealing with a higher GDP growth, a longer project lifetime and different shadow prices. In hindsight, the transport demand analysis failed to take into account the development of the highway network in Spain, the development of a competitive air transport market and the integration of the EU, including its impact on transport demand, regulations and market operation. Transport policy variables were handled as constant for the whole lifetime of the project (30 years). The ex ante evaluation completely lacked a reference scenario for European transport and was limited to the one focusing on Spanish passenger rail transport.

TGV Paris – North  Two scenarios were taken into consideration: these scenarios were only the continuity of past trends for the growth of GDP, but the results were very different to the expected results (the traffic was 19,2 Millions passengers in 2002 instead of 38,7 expected in the public enquiry for 2002). In other words there was no scenario including breaks in trends which could be expected when including EU pace of integration and achievement of projects. For a project like TGV North, with its trans-national character, the existence of a reference European scenario and a common strategic forecasting tool would have supplied a common basis of analysis for the 4 countries involved in the project. A better consideration of regulation policy of EU would have been allowed a better evaluation of the consequences of liberalisation policy of air transport and a better evaluation of expected traffic coming from air transport.

TGV Mediterranean  The scenarios were more oriented towards national market since a large share of the potential market was supposed to be the national market, at least for the next twenty years before realisation of HST extension toward Spain and to Italy. The network effect limited the uncertainties about demand, although some uncertainties were coming from air competition appraisal as mentioned earlier. The new traffic, induced traffic appraisal, which should have been supported by scenarios analysis, was indeed estimated fairly roughly using elasticities techniques. However scenarios were detailed as far as the general economic growth is concerned.

A20 – Baltic Sea Motorway case study. Common European (reference) scenarios are most relevant to mitigate strategic bias in the demand analysis by national authorities. In case of the A20 such a bias was obviously at stake by having been too optimistic about the rehabilitation of the eastern German economy. In another respect, the future relevance of global transport flows and accordingly of port hinterland traffic could have been detected and the options analysis could have been changed by improving the good connections to the Baltic Sea ports (Rostock, Schwenemünde). Resultantly, the “northern” instead of the “central option” could have been selected. Finally, selecting the option of only upgrading the existing federal road instead of constructing a new motorway, would only have been chosen in case the European scenario had delivered clearly lower forecasts than the national expectations.

Waterway Crossing Magdeburg  The expected demand on the link was highly overestimated due to the expected boom in transport volumes from East Europe to Central/West Europe. Caused by increasing time sensitive deliveries, the reduction of warehousing and decreasing freight prices for road transport, inland waterways volumes did not increase as forecasted. Common European (reference) scenarios might have reduced strategic bias (always in one direction) in the demand analysis by national authorities.
Malpensa Airport  The problem of future scenarios is fundamental in Malpensa case. The history of decision making evidences that the objectives – and then the strategy of the airport – changed over time. This generates a multiplication of transport scenarios, also among different stakeholders. The demand estimation for the airport followed very simple procedures: all forecasts, except the ones that came after the ’90s, consisted in simple extrapolations of past trends, with no consideration of changing market context. The effect was a noteworthy underestimation of demand. The use of a common EU scenario for the main inputs (such as oil prices or GDP, heavily influencing the air sector) and the use of a standardised set of forecasting tools, would have positively influenced both context analysis and demand analysis (and consequently the assessment), by providing common and robust assumptions, especially for the base case. The formulation of more complex scenarios than the pure infrastructure expansion would have evidenced the opportunity to invest in technological improvements of existing facilities (as happened anyway). Similarly, the consideration of EU regulation policy would have evidenced the possibility of a non centralised air market (i.e. concentrated into few big hubs), but spread into a large number of smaller regional airports, as liberalisation caused especially in Italy. Even more relevant, the non consideration of the huge European HSR plan that is supposed to connect all the major cities of Europe could have been taken into account.

High-Speed Rail – Connection- Cologne - Rhine/Main. The high degree of uncertainty on the considered scenarios for the high-speed connection between Cologne and Frankfurt underlines the advantage of a common EU scenario. The combination of a general European reference scenario with a set of future national scenarios seems greatly important to reduce the scope of action for decision makers and to avoid goal-driven results.

Electricity connection project between San Fiorano (IT) and Robbia (CH). The use of reference EU scenario would have surely constitute a solid basis for different stages of the evaluation. It would have provide the demand analysis with reliable input data e.g. on physical electricity exchange flows or capacities. Moreover, the existence of a forecast tool at European level, or at least of valuable forecast data on the variables mentioned above and others e.g. power production data, would have consequently improved the option analysis, thus enabling to compare on a solid basis not only alternative routes for the connection line, but also different modes such as the installation of a new power plant as a different option to the line.

3.1.4 Evaluation methodology

Difficulties could be also documented about the evaluation methodology. First, it emerged the absence of a formal CBA evaluation methodology including reference to common scenarios for socio economic environment and valuation of external effect. Second, it was highlighted the lack of a decision process procedure including different stages of evaluation from general consideration about the definition of a project up to the implementation phase, including arrangement with stakeholders, public consultation and publicity.
3.1.4.1 An agreed procedure for ex ante evaluation

The introduction of a European standardised methodology for ex ante assessment may reduce national political goal driven results. In an ideal situation an agreed procedure minimises unprofitable infrastructure projects. For comparability reasons a general approach is preferable especially for cross-border investments.

**Eurotunnel** There has been agreed methodology for ex ante evaluation between experts and national institutes, consulting companies. But the arrangement about evaluation methodology probably cannot be considered as an agreed “procedure”. Differences still existed between French and British presentation of CBA, with differences as far as value of time is concerned.

**Madrid-Sevilla AVE** The methodology for the AVE project was based on the *Manual de evaluación de inversiones en ferrocarriles de vía ancha Volumen I-II, 1985 – 1991*, by the Spanish Ministry of Public Works. The problem lies in the fact that the framework and guidelines are quite relaxed, allowing room for different interpretation in each project and the selection of assumptions and hypothesis that can introduce a bias in the analysis. This is particularly important in the economic analysis part, where generous assumptions on the indirect economic benefits of the project were used to compensate the negative financial evaluation. The use of shadow prices and conversion factors is used extensively, but perhaps a re-examination of the values used for Spanish project would be advisable. Employment and employment costs are treated as benefits, instead of costs.

**Öresund fixed link** Information on methodology, parameters, variables and the decision making process which have been derived from research projects (e.g. Heatco) and official publications show that the assessment methodology is complex and detailed. An Environmental Impact Assessment (EIA) is compulsory during decision making process for transport infrastructure investments. For the Öresund fixed link, comprehensive analyses have been carried out at different stages of the project which reflect the bi-national character of the project. An agreed approach for EIA can use the general requirements of Sweden and Denmark for the fixed link across the Öresund as a foundation.

**A20 – Baltic Sea Motorway** An economic analysis was carried out, but not with an open scope form. The introduction of a European standard methodology for ex ante project evaluation could have helped to reduce goal driven and to introduce global dimensions. The environmental impact assessment was applied. The EIA clearly impacted on the options analysis in form of a thorough consideration of the route of the A20 in the ecologically very sensitive areas around the Mecklenburg Seas and impacted on the construction of the road. For instance the EIA of the A20 gave birth to the concept of “green bridges”, which has become a standard element in the options toolbox of German road planning. From this point of view, the EIA of the project can be considered a good practice example for drafting a standard procedure for Europe. A crucial issue is the consideration of regional impacts. The procedure applied by the German investment plan is frequently criticised being too crude, naive and over-optimistic. This weakness in the planning process would well be overcome by a sound European procedure.
Malpensa Airport Concerning the economic analysis and the analysis of uncertainties, a common framework is needed and would have been very effective for Malpensa, because no CBA assessment was undertaken. Moreover, an assessment including not only the aspects of efficiency, but also the distributional aspects, would have evidenced the risk-takers and the extent of public funding compared to actual financial needs of the franchisee. Shadow prices for employment aspects could have been useful to evaluate independently the extent of regional impacts and the trade-off with their social cost. The environmental impact assessment was not applied in the standard European form since the beginning, because the first project was issued before the implementation of EIA norms into Italian body of laws. Finally, Malpensa was assessed using a different approach than economic analysis. An impact analysis has been performed, trying to evidence the (positive) impacts of the investment on the surrounding region.

Energy projects also suffer from a lack of agreed approaches. The electricity connection project between San Fiorano (IT) and Robbia (CH) case study seems not to follow any existing evaluation methodology, especially for the demand analysis. Projects of electricity interconnections are owned and operated by private company of the energy sector, therefore they are used to conduct their own analyses based on their own assumptions and methodologies. The same holds for the economic analysis. From the Italian part, a classic CBA was realised taking into account several scenarios depending on the transmission fees considered.

3.1.5 Involvement of different stakeholders

Output indicators are not necessarily parts of CBA methodology. But they can clarify the debate and provide concrete benchmark for the motivation of different stakeholders. The formulation of outputs indicators should correspond to different categories of objectives of different stakeholders or decision makers. But in the projects considered the level of disaggregation of the indicators is often too narrow. The most general case is given when importance of international transport was not taken as indicator for EU objectives. The case studies show, together with some positive experience, also the importance of considering relevant stakeholders, (like for instance in the Eurotunnel case study, the constructing companies and the companies supposed to operate afterwards, or in the Malpensa airport, Alitalia and the concessionaire). Also, for the populations concerned, it is important to make available quantifications of impacts so that public debate can be clarified and becomes more transparent.

In the case study of the CH-IT cross border electricity connection the multiplicity of stakeholders within the case study shows a clear involvement of all categories of actors, even e.g. public associations opposed to the project for environmental reasons. This resulted in different classes of objectives according to the time period and the geographical level considered. For this reason, the suggested formulation of output indicators for different families of stakeholders could have had a positive impact on the decision-making process by improving considerably the information available to the public.
Eurotunnel

The private initiative character of the project decided by the national governments limited the debates between different families of stakeholders and different levels of public institutions. However regions were concerned about economic impact of the Channel tunnel and did integrate this new link in the regional master plan in order to improve the access to tunnel and help regional development related to these new traffics. An observatory was set up, researches developed about tunnel impact in Kent and Nord Pas de Calais regions. However, the analysis of regional impacts remained an academic research with not much access to new data: traffic analyses across the Channel remained largely a field for private parties concerned.

TGV Paris – North

French governments have implemented different stages of consultation for infrastructure projects during these last 30 years: regional consultation to elaborate “contrat de plan Etat-régions”, and regional master plan where the projects must be included. Citizens are nowadays also consulted in the framework of the National Commission of public debates and during the public enquiry. The state services, the elected representatives and the local associations are also consulted. In this context the Paris - North case is the first case for which important discussions took place for implementation of ex post evaluation. This series of regulation processes were the consequences of conflicts arisen between inhabitants of the areas touched by the infrastructure project and the public authorities.

TGV Mediterranean

More and more families of stakeholders are part of the decision process. Among these families there are, in particular, infrastructure managers and rail operators, national authorities and local authorities (regions, communes). A recent issue relevant also for the TGV Mediterranean concerns the infrastructure charges for HSTs. With the creation of infrastructure management companies, it is important to raise this problem at the stage of the evaluation process because it impacts the way the new infrastructures will be financed as well as the strategy for the use of infrastructures. The tariff set today for use of infrastructure in the Rhône Valley is influenced by the results of the evaluations which provided a framework for long term strategy of the actors concerned. In addition to this, regions and local authorities are more and more asked to participate to the financing of the projects, which can be limited or not to construction of access and terminals (stations for example). In case of TGV Mediterranean, local authorities mainly participated to such terminal investments. It is therefore important to agree on indicators (employment for example) in order to motivate such involvement. For the populations concerned, population living in regions served and population living close to infrastructure it is also important to provide valuation of impact like accessibility or noise, so that public debate can be clarified and becomes more transparent with possible reference, at national or European scale, to guidelines for monitoring evaluation of such impacts.

A20 – Baltic Sea Motorway

In case of the German Unity Projects the presence of stakeholder groups was rather weak for two reasons. First, there was a common consensus that the West had a high responsibility for helping eastern Germany to re-establish its infrastructure systems in order to provide an as encouraging as possible basis for the economic development in the new federal states. Second, environmental activist groups was not well organised in eastern Germany. A serious problem was the shortening of planning times, thus restricting room for public claims. Instead of the rather open procedure in common German transport planning, the “Planning Acceleration Act” published for the German Unit Projects limited these possibilities. This simplification, which addresses all elements of analysis, planning and design of infrastructures, is not acceptable for strategic project.
On the other side, however, in the case of **Waterway Crossing Magdeburg** the common procedure for infrastructure investments followed the well defined structure in Germany. These are reasons why the decision making process in Germany usually takes years. A European approach may tighten the procedure and give strict guidelines to achieve more efficient processes without restricting the possibilities of stakeholders.

**Malpensa Airport** The problem of lack of consideration of the different categories of objectives of the different stakeholders or decision makers is relevant for Malpensa case. The main stakeholders had very different objectives concerning the investment. For instance EU was interested in providing intercontinental access to Northern Italy, while Italy aimed at giving Alitalia a own airport for the partnership with KLM. Thus, the formulation of indicators could have been very useful to evidence winners and losers in such an articulated decision making process. Also, in the financial and socio-economic analysis, the large financial profitability of the airport was underestimated. This let the concessionaire to have larger national funds than necessary. At the same time Malpensa environmental problems were amplified by locals in the first years. Also in these cases a more formal and transparent procedure, possibly using continentally agreed indicators, would have helped the acceptability.

### 3.1.6 Incompleteness of the analysis

#### 3.1.6.1 Financial and Environmental analysis

Financial analysis is often missing in evaluation of projects (A20 – Baltic Sea Motorway, Waterway Crossing Magdeburg, Malpensa Airport, High - Speed - Rail – Connection- Cologne - Rhine/Main), giving the impression that there is no limit in public funding. In one case (TGV Paris – North) the financial analysis was very detailed but, while there was awareness that costs were becoming higher during the period before the beginning of the construction, this had no real consequences. On the contrary, the TGV Mediterranean evaluation can be presented as an interesting example for correction of financial assessment during the decision process.

A second area of incompleteness of the analysis concern the Environmental Impact Assessment. The EIA assessment was carried out for some projects (TGV Paris – North, A20 – Baltic Sea Motorway, Malpensa Airport, Madrid-Sevilla AVE), not since the beginning of the process, but when the project was more or less in an advanced phase, sometimes after the beginning of the constructions works or even during the first years of operation.
**Eurotunnel** The Eurotunnel project has often been presented as an infrastructure success but a “financial failure”. This does not mean at all that financial analysis was missing since banks had been very much involved in this project from the financial side. The incompleteness of the financial analysis comes indeed from: (i.) the interface between market analysis and financial analysis with weak revenue assessment; (ii.) the inadequacies between political responsibility (the political support of the project) and financial responsibility (no public funds). One major lesson of the project is probably that very important infrastructure investments cannot develop independently of public objectives and therefore independently of some kind of public financing or guaranties. It should be considered that the completeness of a financial analysis is not only an elaborated financial solution, it is also a strong relation between financial risk and responsibility in the good achievement of the project.

**Madrid-Sevilla AVE** The financial evaluation of the AVE project treated investment costs as a public subsidy and did not properly consider them in the financial analysis. As a result, the profitability of the Madrid-Sevilla AVE was calculated by comparing only income with variable costs, without taking depreciation into account. Also, the ex ante analysis for the AVE project did not take mitigation costs into account nor there is information available on their actual level. Not considering such costs is a frequent reason for the increase in project costs during construction and operation.

**TGV Paris – North** The financial analysis was very detailed. This financial evaluation was upgraded at different stages before the beginning of the construction, nevertheless the final costs of the construction were 25% higher than planned in the Public Utility inquiry. The ex post analysis noticed that the exploitation doubled in comparison with the Public Inquiry. Therefore there was awareness that costs were becoming higher, but this had no real consequences. Construction costs also proved to be higher than expected, mainly because of environmental protection works which were not initially planned. In the beginning of 80ies and in the 90ies a series of laws and memorandums were voted in order to deal with the social acceptance of the infrastructure projects and for a better consideration of environmental questions. But at the time of the ex ante evaluation of the Paris North project such procedure did not exist and the EIA assessment was made at a later stage before public inquiry, when the project was quite in an advanced phase.

**TGV Mediterranean** Financial analysis was fairly detailed. After a first evaluation of the project in July 90, the traffic growth trend appeared lower than expected. This raised a risk of deterioration of the rate of return, therefore a correction of the evaluation was asked by the ministry, including a sensitivity analyses to GDP and air traffic. Updated estimations were made with new hypotheses for terminal construction and possible public contribution (national or local). Detailed environmental impact analyses were produced during the preliminary phase when the project was contested by local populations.

**Öresund fixed link.** Financial data are available for the Öresund project which is in contrast to most other infrastructure projects. The fixed link investment was paid by loans raised on finance markets with guarantees from the two governments. All loans have to be paid off by tolls and charges for the use of the fixed link. The fixed link is owned and operated by Öresundsbro Konsortiet. Therefore, a financial analysis included in the annual report of Öresundsbro Konsortiet is compulsory. Data on revenues, operating costs, depreciation, cash flows, borrowings, debts, financial risks and profitability are published annually.
A20 – Baltic Sea Motorway. The A20 is a purely public project with the vast majority of funds coming from the federal ministry for transport, so funding problems were not an issue. After project completion the availability of cost and financial data is poor. At the time of planning and construction there were not agreed rules on environmental impact analyses. Later on, a detailed EIA was carried out for the single construction segments, but they did not impact the general alignment of the project through the ecologically sensitive area of Mecklenburg Western-Pomerania, nor did they provoke more radical alternatives.

Waterway Crossing Magdeburg. Also the Waterway Crossing was completely public financed. The project ranked well after the economic assessment, but again few data on the expected and ex post real investment costs of the project are available. An Environmental Impact Assessment (EIA) was carried out at the beginning of the evaluation process.

Malpensa Airport. There is a lack of detailed financial figures for the airport investment, except the total cost. There is no reference to neither airside nor landside revenues. The lack of a public financial analysis at the moment of request of funding was hiding the large profitability of the investment. The issue of the environmental assessment in the case of Malpensa is twofold. On one side the airport suffered of violent opposition from the local level (mainly citizens) during the very first years of operation. On the other side, these upsets did not influence the actual operation of the airport. However, the environmental aspects influenced partially the development of the airport: the flight routes were modified many times in order to reduce the impacts on built areas; the third runway, which was supposed to minimise the impact of the routes, were never built due to its position inside a regional protected area. An EIA integrated since the very beginning with the design process would have minimised the initial upsets and, even if not driving to a better design, would have evidenced the heavy environmental constraints of the chosen location.

High - Speed - Rail – Connection - Cologne - Rhine/Main Few data on the expected costs of the project are available as well as aggregated ex post data on the real investment costs. The high-speed connection was completely public financed. Costs increased constantly over the planning period but an adjustment of the economic assessment was never carried out. Here the lesson is that general European guidelines for an efficient assessment infrastructure investments should define a major role for the financial analysis in the decision making process. A continuous update of the analysis should be recommended but also that its results may influence the design, scope and finally also the decision of the realisation of the project at different stages of the project and not just at the beginning of the planning procedure.

As far as the energy projects are concerned the private status of electricity network operators seriously reduce the possibility of gathering financial information related to electricity transmission network expansion projects. This was the case within the case study of the CH-IT connection, where no financial analysis was available, neither from the Italian side nor from the Swiss one. An agreed procedure for financial assessments would therefore not improve the availability of those kinds of documents. The impact of any recommendation would be minimal in the energy sector given the private status of the majority of power network owners and operators.

3.1.6.2 Risk analysis

Project evaluation is a forecasting exercise and for this reasons it is characterized by uncertainties. The main instrument to deal with these uncertainties is risk analysis.
For many of the selected projects there is no information available whether a thorough risk analysis was carried out, but in many cases this is probably not the case. Only construction risks and the entailed financial implications during the construction phase were considered. In some cases only sensitivity analyses were made, but a systematic risk analysis was not undertaken in any of the project considered. Namely, only four projects among the selected ones included an analysis of the uncertainties in their appraisals. These analyses are mainly limited to sensitivity testing of project outcomes. In no cases a probability analysis was implemented.

In the case of **TGV Paris – North**, lessons from the past were in some cases misleading: the overspent of the budget was not considered as a major risk for the since former HST projects evaluated (Paris Lyon, Atlantic) were fairly successful as far as infrastructure costs are concerned. For the Atlantic TGV, some construction contracts resulted even below what was initially planned.

In the case of the **Mediterranean TGV**, the sensitivity tests was done in the second step of the evaluation process when economics context with lower GDP growth called for a revision of the project. The risk of lower air fares, in the expectation of a fierce commercial battle between air and TGV between Paris and Lyon was also a motivation to deepen this aspect of the risks.

The **A20 – Baltic Sea Motorway** case study leads to different remarks. An earlier consideration of the construction risks, the entailed financial implications and additional environmental risks could have caused a less risky alignment of the road through more solid land (northern variant).

The **Malpensa Airport** case study showed a much more important aspect associated with risk, but not referred to some specific variables. The airport success, in fact, was associated with some necessary conditions (the alliance between Alitalia and KLM, the semi-closure of Linate, the acceptance of a consistent reduction of the Rome Fiumicino hub, the availability of effective surface transport infrastructures) whose contemporary lack would have heavily threatened the future of the project. Unfortunately, the probability and the risks associated to many of these conditions were underestimated or were not made explicit in the decision process.

### 3.1.7 Continuity and transparency of decision process

In a decision process there are clearly different steps from prior general investigations to the definitive evaluation. The evaluation methods have to be adapted to those different stages starting from a simplified approach at the beginning of the project process and moving toward more detailed analysis once the project has been defined. Furthermore, ex post evaluation and monitoring should be part of the project cycle and the decision making process. Only a continuous process from the ex ante to the ex post will allow to modify and readjust the analysis and the assessment that are contradicted by reality, through an ongoing feedback process between the operating results and the assumptions used (either in future projects or in the same project if there are still margins for readjustments). Finally, the decision making process requires transparency, it is important therefore that all the relevant documentation concerning ex ante and ex post assessment is made public. The case studies show that both these aspects, continuity in the assessment process and transparency, were not sufficiently considered.
Eurotunnel  Transparency was very limited because of the private character of the project: it is still difficult to access financial reports. And nothing was really attempted during the long phase of construction in order to correct the evaluation although it was obvious that initial hypothesis concerning transport market would have not been realistic.

Madrid-Sevilla AVE  The decision-making process for the Madrid-Sevilla project was not completely transparent and several choices were made based on non-technical or economic criteria. The overall plan for an AVE network in Spain was significantly delayed due to problems of social and political acceptability, mainly concerning the issues of funding and regional competences in the design and prioritization of projects. The original Madrid-Sevilla link did not face big opposition from environmental groups (perhaps exactly because of the lack of transparency and therefore awareness at the time), but other infrastructures were delayed until environmental problems were dealt with sufficiently. There is still, however, no agreed procedure in Spain for an open public debate at the stage of project planning.

TGV Paris – North  Paris North is the first project in France for which the entire ex ante, ex post decision process have been tested. TGV North was included in high speed rail master plan. Along all the phases of the project, reports and documents were provided to authorities but they were not necessarily public. In France, since 1995, the so-called ‘law Barnier’ introduced a “debat public” process relative to the consultation of public and associations upstream of decision concerning great operations of development of national interest. The Commission of Public Debate (CNDP) was created to organise this public debate. This debate start when the ministries interested in the project give their opinion. But for TGV North only a Public enquiry was done.

TGV Mediterranean  The experience of TGV Mediterranean evaluation process was at the origin of proposal for more transparency, and more public debates which cannot be indeed dissociated. A clear identification of a project management structure also helped in this way of improvement of the procedure, although the initial objective of this structure was more the tracing of possible cost deviations.

Öresund fixed link  The time period between the ex ante assessments in the 1980s and the final decision in 1991 was rather short so that continuity was not a big and critical issue for the Öresund fixed link. However, it should be noted that transparency (including the publication of information and data) on planned (ex ante) and realised (ex post) investment projects is still very limited: data and assessment reports are incomplete, unavailable or confidential.

A20 – Baltic Sea Motorway  For this project, the demand analyses and the related decision process was cut into small pieces, taking place shortly prior to the construction of the single motorway segments. This process can be considered being continuous, however in none of these planning stages ex-post evaluations were foreseen. Knowing that the results of the demand analysis would have been subjected to later review could have corrected some bias towards overestimations, which were evident at least for the later sections of the road. Formal documentation on the decision making process and on subsequent strategic decision are not available to the public.

Waterway Crossing Magdeburg  In Germany, the decision in favour of an investment project is usually based on the results of the first assessment. A reassessment caused by significant changes in investment costs, demand forecasts, environmental impacts, etc. is very uncommon and could hardly be found. Ex-post evaluations do just not exist. As for the Baltic Sea Motorway, the awareness that the results of the demand forecasts would have been reviewed ex-post might have reduced some optimism bias. Because of the very short period of the decision making process for the Waterway Crossing, continuity did not play a role at all: the project was planned in the early 1990s, it was included in the German Federal Transport Investment Plan (FTIP) in 1992, construction works started in 1996 and is was finally opened in 2003. Formal documentation on the decision making process are limited and sometimes not available for the public especially when it comes to detailed ex post data.
The process of Malpensa, from the initial proposal to the opening, has been quite long (more than ten years) and meantime the stakeholders involved, their objectives and the overall economic and regulatory context changed completely. However, not only the project was subjected to a limited assessments at the beginning of the process, but the decisions taken lasted unchanged until the opening of the facility. The decision process was not delayed before the opening for lack of social and political acceptability. However, transparency about relevant data concerning all the aspects (financial, environmental, socio-economic, etc.) would have allowed the project to perform better and to evidence better solutions. The transparency was very low especially concerning the context, the financial figures and the socio-economic profitability. Demand aggregate figures were available, and in fact, were nearly the only non-environmental aspects contested during EIA public examination.

Because of the very long time frame between assessment and realisation of the infrastructure project, continuity would have played a significant role but has totally been neglected. Ex-post evaluations of infrastructure projects are just not existing. Data on the results are only available from secondary sources. Formal documentation on the decision making process is hardly available. The same can be observed for actual passenger data which is confidential and only available at the Deutsche Bahn which refers to competitive disadvantages in case that link specific data are published.

From the study phase to the end of construction works, the overall process of the case studied lasted about 23 years, from 1981 to 2004. This long process was subject to different mutations in the stakeholders involved and in their objectives. A continuous process would have offered more transparency to the project and contributed to a more efficient economic analysis. The project faced local oppositions lasted more than 20 years. It is clear that an appropriate documentation together with the organisation of a public debate would have increased the involvement of citizens and improved the acceptability of the project. For example the requirements of opponents to the project, e.g. from mountain associations, were typically about environmental related topics, which led to a revision of the route of the connection line. The publication, at an early stage of the project, of the main results of a detailed environmental assessment would have increased project acceptability.

### 3.2 Suggested areas of improvements

The most promising areas of improvements were identified on the basis of the results of the re-examination of the case studies, combined with the results of other recent similar studies. It was possible to find out evidence of the effectiveness only for some of the proposed improvements, as only part of them could be effectively processed in the case studies re-examination and mainly in a qualitative way. As stated in the conclusions of the ex post analysis of the selected projects, a full assessment has not always been possible for all the projects owing to the heterogeneous availability of information and data, this is particularly true for the financial and economic analysis for which major difficulties have been encountered in the data collection. The suggested improvement’s area are summarised in the following figure and presented in the remaining part of this paragraph.
**Figure 3.1 Areas of improvements**

![Diagram of Areas of improvements]

**Improvements in the ex ante analysis**

The case studies have shown that in many cases the ex ante analysis were incomplete and the approaches heterogeneous. In relation to the ex ante analysis the most promising areas of improvement aiming at tackling the main distortions emerged from the case studies were identified in the importance of applying a common assessment methodology based on the most recent approaches. The common methodology should consider the need, for the ex ante analysis of large, cross border infrastructure to go beyond the national dimension as well as the relevance of the issues related to projects interdependency and to the effects of imperfect competition and strategic behaviours of operators on market prices. A common assessment methodology would also take advantage of a common modelling approach. The basis for possible improvements in the estimate of generated traffic and in impact analysis are concisely discussed, together with the importance of a well structured financial analysis, which as shown by the case studies is often incomplete or non available. Finally within the improvements of the ex ante analysis the introduction of the EIA at early stage of the projects is considered as particularly important for a more effective assessment process.

**Improvements in the estimate of the demand**

One of the strongest evidence from the ex post analysis of the case studies is demand overestimation. There are many reasons behind this tendency and the risk analysis can help in dealing with it. But there are also other tools that can help reducing the uncertainties of demand forecasting. From the point of view of large TEN infrastructure projects, there are some components of the demand that play a significant role: these are all linked to the interdependence between national and European transport.
Passenger and freight international flows are a relevant component of TEN projects transport demand and too often such component is estimated at an aggregated level (i.e. from country to country and not from region to region) and this does not allow for accurate network assignment.

This is quite important, especially considering that international flows are recognized to be growing faster than national flows. In fact, in most EU countries, and particularly in the transit ones, international transport reaches a significant share of the total TEN-T network traffic, rarely lower than 10 or 20% and sometimes higher than 50%. This share is higher for rail infrastructure, which is a priority of TEN-T guidelines, and it is a growing share according to the previous remarks. Therefore, a better understanding of international flows development, analysed at the opportune scale of origin and destination, can contribute to better predict the evolution of traffic also on national networks.

An helpful improvement concerning demand forecasts at the European level could be the adoption of a common reference scenario. A further progress on this respect, would be the availability of data particularly on international and long distance flows.

**Risk analysis and risk management**

Demand overestimation and cost overrun are a common feature of the large infrastructure projects considered. Although the pattern of costs overrun might seem similar across projects, the causes typically differ. It is not possible to find one single reason for the deviations between ex ante and ex post, different factors occurred for the different case studies. What exactly causes costs overrun is difficult to predict, but for sure the decision making process plays a significant role. The decision process for a large project might take 10 to 20 years, although there are examples of shorter decision processes (around 5 years at minimum), but also longer ones (more than 30 years). In addition to the length of the decision process, one might add around 3 to 5 years for construction and at least 3 to 5 years for “maturation” of the new project implementation.

Even if the availability for data and scenarios will help reducing inaccuracy in demand forecasting, a quantitative risk analysis and a subsequent plan for risk management and mitigation are of paramount importance for improving the performance of large infrastructure projects. It is important that a proper risk analysis is undertaken, and not only sensitivity analyses concerning e.g. a pessimistic and an optimistic scenario, because only by taking into account the probability associated to uncertain aspects it is possible to provide quantitative elements about the robustness of costs and benefits estimations. Therefore it’s highly recommended to extensively use the so called reference forecasting to correctly consider the divergence between the ex ante expected impacts and the ex post observed results.

**Analysis of past experience**

The case study re examination highlight the relevance and the usefulness of carrying out ex post analysis not only because it allows to trigger a positive process of continuous refinements and improvements of the ex ante approach, but also to reduce optimism bias through the reference forecasting transparency.
Improvement in the decision making process

In order to improve the decision making process for large infrastructure investment projects, it is important looking at the entire project cycle, from ex ante to ex post with comprehensive approach. The improvement of decision process will mainly rely on increasing the transparency of decision process, in an effort for clarification of objectives, and access to information, including results of evaluation. But, in parallel, it must be made clear that the decision process is a continuous process with different steps from initial proposal to first evaluation, public discussions, defined analysis, implementation up to following up of the effects. At each stage corrections can be made and estimations reviewed, but, in any case remain transparent. The decision making process can finally be improved through the formulation of outputs indicators for different families of stakeholders. The formulation of outputs should correspond to different categories of objectives of different stakeholders or decision makers. The positive contribution of increased transparency and a more organised stakeholder involvement through the formulation of ad hoc output indicators is will take significant advantage from the setting out of a supporting unit at the EU level.
4. Guidelines for ex ante and ex post evaluation

4.1 Introduction

This chapter provides the final guidelines for methodological improvements for ex-ante and ex-post evaluation of complex projects that are considered strategic in the development of trans-European transport and energy networks. TEN projects are typically the results of rather lengthy process that involves various administrative levels, as well as political institutions, consultants, contractors in the private sectors and different stakeholders. As a result, the decision process takes place during a period of time which is, for most of the projects, a “very long” one. Objectives might change during this period, and the time dimension of the decision process must be integrated and managed because it might distort the evaluation results and the information associated to each step of the process. This process is usually complex, and what happens during this front-end phase is essential for the project success.

The guidelines recognise that the evaluation of a project is never conducted once for ever, but rather has to be considered as an evolutional process that encompasses the project life, from the initial concept to the operational phase. As a consequence, the main focus of the guidelines is not on the scientific and methodological issues, although these are a prerequisite of the recommendations, but on the interactions between ex-ante appraisal, monitoring and ex-post analyses, including the decision-making and the policy dimensions.

The traditional project appraisal approach proceeds from very general to very specific assessment: for instance, the local environmental assessment is likely to be detailed in last stages only, when local impact can be known with precision. The major inconvenience of this approach is that at the first stages of the process, the environmental aspect is very general and that at the later stages the economical assessment is not sufficiently reviewed. The result is that the project that has been appraised is not the one that is going to be realised and, what is more important, the appraisal has not been used to select the best layout.

An appraisal approach that aims to really support the decision making process must adapt to the different stages with more detailed analysis when the project has been defined. This asks for the need to consider the whole decision process including project monitoring and ex-post evaluation as a continuous process with different stages. In this comprehensive approach, the ex-post evaluation should enable the ex-ante evaluation procedure to be fine-tuned through an ongoing feedback process between the operating results of existing infrastructures and the assumptions used to evaluate new capital expenditure decisions.
This “project cycle” has different stages, from preliminary appraisal to ex-post evaluation, each stage links with the preceding one and links forward to the next one. This requires that interrelations between ex-post and ex-ante evaluation are taken into account since the beginning of the project appraisal in order to make the whole process more accurate.

The time dimension is important in the project cycle from ex-ante assessment to ex-post evaluation. The whole process must develop in a smooth way since changes of objectives or contestations, which are legitimate, might influence ex-ante and ex-post results. Possible changes and implementation problems must also be considered in the evaluation process definition. The time necessary for decision making processes cannot just be considered as a “delay”.

Finally, conservation of data and information of a project history as well as transparency are important steps toward progressive approach to project appraisal and evaluation. Keeping memory of the project appraisal and monitoring is a pre-requisite for ex-post evaluation. A weak point of the evaluation process pointed in the case studies is the frequent changes over time of the institution or organisation in charge of evaluation, within or outside Ministries. This will imply in particular that there is no “memory” of the evaluation process which makes it very difficult for ex post evaluation. The efficiency of the ex-post evaluation system is directly related to the content and clarity of the information provided by the ex-ante appraisal and the monitoring system. Furthermore, the relevant project documentation must be made available to the public. A smooth evaluation process requires a transparency and the capability of integrating positions of different stakeholders who can be “partners” of the decision process. This means planning of concerted phases with public and private authorities.

The chapter is structured following the steps of a project cycle that starts with the ex-ante appraisal and the monitoring of the project implementation, looking afterwards at the ex-post evaluation and at the feedbacks with the ex-ante. Recommendations are given in an operational progressive perspective and, whenever possible, the different steps and recommendations are supported by examples of best practices.

4.2 Ex-ante analysis of large transport and energy infrastructure projects

4.2.1 A dynamic approach to ex-ante appraisal

The decision making process of large infrastructure projects takes place during a period of time which is, as shown by most of the projects considered, a “very long” period of time: for major transport infrastructures it is quite often a period which extends over 10, 15, 20 years and even more. Objectives might change during this period of time and the time dimension of the decision process must be integrated, managed and controlled because it might distort the evaluation results and the information associated to each step of the process. Consequently, appraisal cannot be made once and for all but must adapt to such different stages, with more detailed analysis when the project is defined, including the links with local and interregional networks.
In reality there are, most of the time, several ex-ante appraisals, and it is sometimes difficult to know what is the document, which should be taken as reference as the ex-ante appraisal on which the decision has been taken. In most case studies it was indeed difficult to date the conclusion of ex-ante appraisal.

A clear structure of the decision making process for large infrastructure projects of EU interest is extremely helpful in clarifying where go/no go decisions are needed. This asks for the establishment of a distinct set of milestones more than strict and comprehensive regulatory design.

Different steps are defined in the ex-ante appraisal, and at each step should correspond to a specific analysis to be adapted to the level of maturity of the project:

- Preliminary analyses with global exploration of the impact of the project including expected environmental impact (see next paragraph)
- More detailed analyses when the project is more mature and the spatial location more precise. At this stage, a concerted process with stakeholders must take place.
- Detailed ex-ante appraisal including official documents required by legislation or regulation in order to satisfy legal aspects of evaluation (EIA, reference to planning documents, agreed reference values for unit costs.)

Within that framework, possible impact on expected outputs of changes of objectives can be highlighted and delays in decision process and implementation will be considered part of the process together with the analysis of the positive or negative impacts on the expected outcome of the project.

Furthermore such an approach, once adapted to the level of debates and analyses that takes place at different stages can be extremely useful in minimising the reintroduction of contestation of the project on new grounds. Decisions are clearly path dependent, and assessing conflicts continuously throughout a decision making process could contribute to resolve potential conflicts before they become actual conflicts.

4.2.2 A progressive approach to environmental analysis

Environmental complaints during the implementation phase are quite often one of the causes of construction time delays and cost overruns. The positioning of the environmental appraisal procedure in the decision-making process shapes both the strategies of the actors involved and the solutions they reach. The sooner the appraisal procedure is confronted with interests and logics of action from the environmental perspective, the higher the possibility to construct a common political ground.

The capability of Environmental Impact Analysis (EIA), when carried out at the very beginning of the project appraisal, to influence the project technical solutions adopted to minimise the
environmental costs to society, as well as to organise the public debate around the project and contribute to reach the consensus should be extended also to the whole assessment procedure.

Environmental issues must also be enforced because, despite the formal recognition of their importance, they are still playing a marginal role, with no real influence in the decision whether or not the project should be implemented.

A similar approach as the one proposed for the ex-ante appraisal is suggested also for the Environmental analysis. By (i) proceeding in parallel with a dynamic ex-ante appraisal and a progressive environmental analysis, (ii) reappraising the project each time it is modified in order to mitigate environmental impacts, and (iii) re-running the environmental analysis each time the project is adjusted a positive dialogue might be guaranteed between environmental and social issues. Through these analyses done in successive stages, the project design that contributes most to the objectives may be selected.

The feasibility of this approach requires that the analysis is designed in a progressive way, providing at each different stage of the decision making process the necessary results without consuming excessive time and resources.

4.2.3 Quantitative risk analysis

The evaluation process necessarily entails a forecasting exercise: assumption on costs, benefits and effects has to be done before they are realized. Large infrastructure investments are inherently risky due to the long planning horizon and complex interfaces. Furthermore, these types of investment are necessarily based on uncertain future events involving explicit or implicit probability judgement and probability-based assessment. The systematic use of quantitative risk approach, together with risk management and mitigation are of paramount importance in improving the performance of large infrastructure projects.

The quantitative risk assessment involves the selection of the variables to which the project design is most sensitive, the assignment of a probability distribution to the selected variables and then determines the effect of varying simultaneously the variables.

The sensitivity testing allows identifying those “critical” variables or parameters, which, positively or negatively, influence more the project results. A probability distribution should then be assigned to the critical variables, identified through sensitivity and scenario analyses. The probability distribution for each variable may be derived from different sources, such as experimental data, literature, consultation of experts.

Since the definition of probability distribution is the cornerstone of a meaningful risk analysis and, at the same time, is often the most challenging task, it is worth exploring possibilities to address this issue.
The quantitative risk assessment involves varying simultaneously all the relevant variables. Many procedures could be used for doing that although Monte Carlo method is currently the most frequently used\textsuperscript{23}. Sensitivity tests analysing the influence of each single variable on the project’s financial and economic performance can provide important information. However, it is recommended that also the interaction effects among relevant parameters be tested through scenario analysis, where more parameters are varied simultaneously.

The main result of the risk analysis is the probability distribution or cumulated probability of the NPV or the IRR\textsuperscript{24} in the resulting interval of values.

4.3. The importance of project monitoring

4.3.1 The project monitoring process

In the progressive approach recommended along the whole project cycle, the monitoring of project implementation plays a relevant role. The monitoring process should look at all factors that may potentially affect the project feasibility. This means that the checklist of the “monitoring” should include not only investment costs, but also the socio economic context, the transport context, the expected impact as regards transport evolution of demand, supply and environmental impact of the project.

4.3.2 Monitoring the project costs

In order to avoid costs overruns and to compare ex-ante and ex-post situations, monitoring and collection of relevant data is of particular importance. Case studies show that cost overruns are not uncommon (see also Flyvbjerg et al. 2002) and literature suggests the following causes for cost overruns: project typology (roads, railroads, technology used); region; project size; length of the implementation period; several categories of uncertainties; changes in project specifications; strategic behaviour (resulting in too low cost forecasts) of actors supporting the construction of the project.

In the case where the differences between the plan and the actual work performance are large, actions are required to bring the actual performance on course with the desired state of the plan. Large differences may require a revision of the model of future work to ensure that it is realistic.

The control cycle involves three stages:

- Measuring the state of the system.

\textsuperscript{23} Monte Carlo simulation is based on generating large amounts of random numbers based on a statistical model.

\textsuperscript{24} Project performance indicators: NPV Net Present Value, the difference between the discounted total social benefits and costs, IRR Internal Rate of Return, the rate that produces a zero value for the NPV.
Comparing these measurements with the desired state of the system.

- Taking corrective action to minimise some losses.

Time lags have been shown to degrade performance. Flyvbjerg concludes that the length of the implementation period is relevant: the longer the implementation period, the larger the cost overrun (Flyvbjerg et al. 2004).

Project monitoring provides quantitative information on which control actions may be based. Whatever the cause of the discrepancy between actual and expected output, monitoring will help in identifying possible ways to reduce the overall discrepancy and reduce the risk of cost escalations due to changes in project specifications.

### 4.3.3 Monitoring the demand

With reference to the demand, rather than comparing the actual and the expected outcome, the monitoring should consider those factors having an impact on the expected demand. This requires controlling both (i) the trends of socio-economic variables affecting demand development, like GDP growth, and (ii) the modification in the transport context, i.e. what is going on the competing modes and/or routes as well as in the policies field (regulation, pricing etc.). Such determinants indirectly impact on the project characteristics and can therefore contribute to a change in project specifications.

All technical decisions leave some degree of flexibility, on order to better adapt to unexpected changes in actual demand. This is particularly true for large infrastructure projects made of different stretches. The actual demand on the stretches firstly open to the public might provide extremely useful information on how to “readjust” the technical characteristics of the remaining part of the infrastructure still under construction.

### 4.3.4 Monitoring the decision making process

Project monitoring should also look at the decision making process, particularly at the relationship with the stakeholders, including those who are not in favour of the project. In such cases, monitoring the stakeholder’s attitudes toward changes in the project characteristics might be extremely useful in order to fine-tune the project with the intention of increasing acceptability and reducing the risk of delays. Before a project owner decides to proceed and build a project, every effort should be made to conduct preparation, planning, etc., in such ways that those problems which may otherwise resurface as delays during the implementation stage are negotiated and eliminated.

### 4.3.5 Risk management and mitigation

“Risk mitigation” objective is to identify possible strategic answers to the more critical items identified through the monitoring and risk analysis. The main questions that a risk mitigation and management plan should give answer are:
• what are the possible options?
• what are the tradeoffs in terms of costs, benefits and risk among the different options considered?
• what are the impacts of the actual decision on future options?

Given a clear understanding of the risks, their magnitude, and the options for response, an understanding of project risk will emerge. This understanding will include where, when, and to what extent exposure will be anticipated. and will allow for thoughtful risk planning.

The purpose of the risk management plan is to identify how the various risks made visible by the risk analysis can be managed and by whom. In practice, risk planning requires first of all to develop and document an organized, comprehensive and interactive risk management strategy describing processes to assess identify, analyze and mitigate the risk associated with a project. Possible options to be considered include:

• more flexible or standardised design (avoiding irreversible decisions),
• better contractual arrangements (transferring risk),
• taking precautionary actions (mitigation), by reducing the probability or consequences of a risk event to an acceptable threshold,
• making the risk takers and those responsible explicit.

4.4 The role of the ex-post evaluation

4.4.1 The objectives of ex-post evaluation

The ex-post evaluation has the following primarily goals:

• increase transparency by giving evidence, given the amount of public money involved, to the effectiveness of the investments in relation to the reached financial, economic, environmental and social objectives (accountability);

• measure the effectiveness: the actual impacts are compared with the forecasted ones or the achievements are compared with initial objectives in order to give a measure of the utility of the project;

• provide elements to improve the ex-ante assessments of future interventions: ex-post evaluation based on the reassessment of ex-ante appraisal is extremely informative and useful for understanding whether the conceptual forecasting model adopted before project implementation was adequate to support the investment decision. Furthermore it allows understanding where the efforts in improving the quality of project appraisals should be addressed.;
- collect relevant information about past projects to be used as reference class forecasting (see paragraph 3.3.2);

- provide incentives for better and more accurate ex-ante analysis by giving publicity to the real achievements of the projects.

Ex-post evaluation is not about discovering “deviations” per se. The understanding of the causes behind the deviations is the real target of the ex-post evaluation. Indeed, what can be learnt from ex-post evaluation greatly depends upon possible separability of impacts of unexpected changes in truly exogenous and partly endogenous variables.

Prices, productivity, some type of costs, etc. are fully or partly endogenous. Here the forecasting errors can be either of the same type as before (weak empirical models, etc.) or of a quite different type: overlooking factors that have led the managers to inefficient decisions. This type of error is more related to project design, asymmetric information, moral hazard, and in general incentive issues. Again, what we can learn is very different and is linked to the origin of the investment cost overrun.

Box 4.1 The ex-post evaluation in France

Since the promulgation of the LOTI (Loi d’Orientation sur les Transports Intérieurs) transport law in 1982, the socio economic evaluation, ex-ante and ex-post evaluation is an obligation for large infrastructure project of national interest in France.

Ex-ante evaluation was already a usual practice within the planning process for road master plans and in particular for motorways construction following a common cost benefit methodology regularly improved by the Transport Department. But there were, at that time, only few projects for rail or inland waterways except for the development of HST lines, which became a policy priority after the opening of the Paris - Lyon line at the beginning of the eighties. No directive was issued for such projects and the socio economic evaluation process, always based on cost benefit analysis, was depending upon the methodology adopted by “ad hoc” commissions set up for specific projects. The objective of the LOTI was to harmonise the evaluation process taking into account all modes, and to have ex-ante and ex-post evaluations as legal obligation.

Considering the life cycle of a project, the ex-post evaluation became indeed a reality at the end of the nineties. The projects which were already parts of a transport planning process (a 5 years process at that time) were not submitted to this new legal obligation. Originally the ex-post evaluation obligation was 10 years after the implementation of the project and appeared more difficult to achieve in the case of rail projects than for the completion of the motorways network, probably due to the higher acceptability of the motorway as a toll to improve regional accessibility - except for sensitive areas where intense debates also took place.
The experience in France is particularly useful although it can be still considered as a learning process: the two last ex-post evaluation reports have been published in 2008 for the Rhone Alps HST, going around Lyon, and the Mediterranean HST between Valence, Nimes and Marseilles which was an EVA TREN case study. RFF (French Rail Infrastructure Manager) was in charge of producing the evaluations which have been discussed by the Conseil General de l’Environnement et du Developpement Durable (CGEDD) in the ministry, an advisory body which has already played an important horizontal role within the ministry, and was recently granted enlarged competencies in the energy and environmental domains (formerly Conseil General des Ponts et Chaussées). The reasons for discussion with CGEDD were indeed to harmonise and constantly improve the methodology of ex-post evaluation. The context for ex-ante and ex-post evaluations has indeed very much changed in France over the past 25 years:

The planning process for transport, at the level of central administration, has been abandoned and replaced by a more decentralised process of concertation with regions: the so-called “Schema de Service”, which also stressed that the final objective of the transport policy is the provision of adapted services, regions have taken a more important role in the choice and financing of large national projects

Consultation obligations with the public have been extended, with obligation of public debate at an early stage of the decision process

New environmental laws for protection of environment have been passed, as well as new obligations in urban planning which must be taken into account within the evaluation process.

Therefore the ex-post evaluation becomes more important in order to point what are the differences between projected and observed results, not only to analyse if the initial objectives of the policy have been reached but also to assess if the quality of information provided to the public before was satisfactory.

This shows clearly that ex-post evaluation is indeed a long, complex, learning process, which must also reinforce the “confidence relations” between the decision makers and the population. The last “Avis” (Advice) of the CGEDD (July 2008) is then particularly interesting to analyse in order to show what progresses have been made in the light of the publication of these last ex-post evaluation reports: two provided by RFF concerning the two lines mentioned before which are closely interrelated (Rhone-Alps and Mediterranean new lines25, and a report provided by SNCF concerning the new stations of Mediterranean HST, showing how the problem of new stations becomes important in the evaluation process and in discussion with region; this is also a new point to emphasize the projections of traffic, in relation or competition with other modes, putting forward measures of accessibility within the modelling process.

Therefore the context has also very much changed since the initial legal obligation taking into account the separation between transport operators and infrastructure managers with expectation of new entrants, as well as growing influence of discussions with public, and environmental impact assessments.

4.4.2 The formalisation of ex-post evaluation steps

The path of a correct ex-post assessment can be summarised as follows. For each step, challenges are manifold as briefly outlined below.

25 Their current denomination in official documents is also LN4 and LN5 pointing out how such project takes place within a more global programme, which is very important as regards “option analysis”.
4.4.2.1 Planning

The planning of the evaluation process needs to start at the project design stage. This step is crucial, because it enables to collect the information needed for the analysis of both the “before” and “after” implementation. In order to provide feedbacks for the improvement of the ex-ante techniques performance, ex-ante appraisal should be well documented: the decision making process is most of the time very long so that afterwards it is difficult to point out which is the ex-ante analysis that was supposed to support the decision. When the project documentation is not available or incomplete, the lack of official documentation of ex-ante assessment results and in general of planning documents makes it difficult to apply sound ex-post analysis.

Given the amount of public money involved normally in the appraisal of projects, the provision of the relevant documentation should be considered as part of the project activities.

4.4.2.1.1 Identification of the project boundaries

This step involves the clear identification of the project boundaries, main objectives and targets.

- Project boundaries should include space and intermodal dimension (all networks where the effects of the new infrastructure are expected to be realised should be taken into consideration), as well as pricing of substitutes and complementary goods.

- Project objectives should be consistent with the ones included in the EU policy or programme priorities.

4.4.2.1.2 The analytical framework

The analytical framework for an evaluation needs to be set up at an early stage, as this is then used to define the data collection activities. The most important questions to answer are:

- Is the evaluation limited to outturns, or is it to extend to processes?

- How many “after” periods are to be explored?

- Will statistical analysis suffice for the evaluation, or are new modelling/forecasting tools required?

The definition of the analytical framework produces specific requirements for the data collection activities: data directly related to the estimation of the counterfactual, data targeted at observing trends, etc.

4.4.2.2 Measure of the project outcome

Collect ex-post information about projects performances is in general costly, so that it is important to concentrate on the main indicators and to use standard approaches. There is a danger that some of the important impacts of a project may not be covered by the stated
objectives (for example, the impacts on other modes of transport or on other countries). These issues should be considered in the evaluation, if they are material.

In addition to data collection, which is the main source for cost, demand and construction times, experts interviews could be useful to investigate on the possible cause of discrepancies between ex-ante and ex-post results.

**4.4.2.3 Comparison of the project outcomes with the expected outputs**

Ex-post evaluation implies comparing the observed outcomes with those expected in the appraisal stage. A key issue is here the understanding that “deviation from initial forecast” is in fact a irrelevant concept. The outcome of an infrastructure project will never be exactly as projected in advance, as there are only very limited chances that the future can be accurately predicted. Thus, it is not sufficient to identify and quantify the discrepancies between the ex-ante appraisal and the ex-post results, rather to assess as far as possible what caused such discrepancies.

Even in those cases where no critical differences emerge, it is not possible to automatically conclude that the ex-ante appraisal methodologies were adequate, since it may occur that exogenous factors which were not considered in the appraisal stage may have generated outcomes similar to those expected.

**4.4.2.4 The counterfactual**

In order to evaluate the project validity (accountability reasons), ex-post evaluation involves comparing the observed outputs and outcomes with a Reference Case. The analysis needs to look at the “after” opening situation against “after-without” the scheme, which is called the counterfactual situation.

The “after-without” case may be represented by the looking-forward situation, as forecasted at the time that the project was approved (the Reference Solution of the ex-ante appraisal). However, if there is a considerable difference between the forecasts made for the scheme and the observed outturn, this also casts doubt on the validity of the Reference Solution and hence their use for estimating the counterfactual: the “after-without” situation is not observable and it may be not the same as the “before” situation. With large projects, the construction and settling down periods can extend over a number of years, and much can happen in that period.

In addition, the comparison ex-post and ex-ante will only be of value if the specification of the project context analysis was sufficiently comprehensive. This is the case where the Reference Solution did not include some projects that were implemented, or - on the contrary - some of the planned projects of the Reference Solution were actually not implemented. In these circumstances, the applicability of the Reference Solution to identify the counterfactual can be improved through re-running the model(s) used in the appraisal stage with updated data on the basis of observed trends (GDP, evolution of transport costs/price of different modes in
competition, etc.), and updated transport networks, that better reflect the outturn in the “after” period.

4.4.2.5 Identify endogenous or exogenous factors

The identification of the counterfactual involves investigating the effects which may be attributable to a project, i.e. the effects that without the project would not have occurred, or would not have occurred at the same level. Some insight into the sorts of changes that have occurred and how they have impacted on transport demand can be gained from data on comparable areas outside the direct influence of the project. This should be supplemented by qualitative research such as in depth interviews with stakeholders and relevant professionals to understand and explain the observed changes.

The key point is whether the deviation is because of endogenous or exogenous factors. While the latter are hardly predictable and outside the control of the project management, the former might be included in the ex-ante analysis to reduce the related risks. Only a careful distinction between forecasting errors in exogenous versus endogenous stochastic variables, and between the latter and the changes in planning parameter applied in the economic analysis, can offer a meaningful ex-post evaluation.

4.4.2.6 Costs evaluation

Costs evaluation is a critical stage of any major project owing to undue optimism. An approach that might be taken to investigate the process of costing a major project could involve asking whether the costs were compared with other similar investments, or use was made of published unit cost or an explicit allowance was made for optimism bias, etc.

Thus a specific requirement of ex-post evaluations should be to investigate the methods used to obtain costs and the reasons behind the divergences between expected and actual costs. The main factors to be considered are: delays in the implementation, changes in the project specifications and design, changes in currency rates, geological risk, changes in quantity and prices, changes in safety requirements, changes in environmental requirements, technological risks. It would be also useful to recall that project appraisal provides the starting point for applications for scheme funding, but there is generally a need for iteration as the funding bodies will naturally raise issues about aspects of the appraisal.

4.4.2.7 Process evaluation

Process evaluation looks at the reasons behind the difference between the observed outcomes and those expected in the appraisal stage from the decision-making process point of view. It involves the examination of aspects of the development and implementation of the project and focus on the strengths and weaknesses of procedures and how they were implemented. This might cover any of the main activities involved in developing the scheme, from objective setting through design to implementation; or it could look at the effectiveness of consultation processes.
in the finalisation of the design - and/or how decisions were made on capital procurement. As with project outcomes and costs evaluation, process evaluation may consider a wide range of areas or be targeted at a limited number of particular issue.

Process evaluation would identify problems arising from adopting “solution-specific” objectives rather than “pure” objectives and would also look at the role played by the environmental impact analysis, whether it played or not a proactive part in the project development process, at funding problems as well as stakeholder and public consultation.

4.4.2.8 Measure the effectiveness of the investment

One of the main objectives of the ex-post evaluation is to give a measure of the project net impact on economic welfare on the basis of the observed outcome and outturns. The analysis needs to look at the “after” opening situation against the counterfactual situation. Once identified the counterfactual and calculated the actual project outcome and costs the evaluation should be conducted in the same manner as the ex-ante economic appraisal and should apply almost identical procedures. The result will be the calculation of the actual economic performance indicators IRR and NPV, to be compared with the expected ones.

Box 4. 2 The New Alpine Transversals (NEA)

| History: | Traffic flows from Northern Europe to and from Italy across the Alps constitute the strongest freight transport corridor in Europe. In front of their strong growth, the ecological sensitivity of the Alpine nature and traditionally important role of environment protection policy in Switzerland has lead to the decision to construct the Alpine base tunnels.(NEAT). After a first agreement by public vote in 1992 and a later re-dimensioning, the final agreement to the project in its present form was taken in 1998 by public vote. The NEAT project is embedded in a series of measures to maintain the high share of rail transport in cross alpine freight traffic, which was at 68% in 1999. These are the BAHN 2000 project for improving capacity of the entire rail network and the connection of Switzerland to the European high speed rail network. |
| Policy background: | On the political side the project has been accompanied by the Transit Agreement between Switzerland and the EU of 1992 and the Bilateral Land Transport Agreement of 1998. The latter has foreseen a stepwise relaxation of the Swiss 28t-limit for trucks to the European Standard of 40t. To balance out this enormous productivity increase for road transport the introduction of a heavy vehicle fee (HVF) on the entire Swiss road network was decided, where the revenues are earmarked to finance the NEAT project. |
| Project specification: | The NEAT project consists of two main routes, Gotthard (57 km plus Ceneri base tunnel) and Lötschberg (34.6 km), for which base tunnels are constructed in north-south direction. While the Lötschberg axes is operational since December 2007, the Gotthard axes is expected to be finalised in 2017. If fully completed the Gotthard axes will reduce the travel time from Zurich to Milan from 3:40h to 2:10h. |
| Ex-ante appraisal: | Before the project start several feasibility studies have been conducted by the Swiss federal government and the Swiss Federal Railways (SBB). The SBB economic study clearly came to the recommendation that two tunnels would not pay off, even within a very long concession period. Nevertheless, due to the political constellations and the decision power of the Swiss cantons only one base tunnel would not have been possible. |
Continuous monitoring: Given the requirements in the bilateral land transport agreement, the public transport financing act (FinÖV) and the NEAT controlling order (NCW) both, the transport demand development and the financial performance of the project are continuously monitored. The financial status, including cost development and final cost forecasts, are made publicly available through the website of the Swiss Office for Transport (www.bav.admin.ch). It is, however, important to mention, that this open culture of communication is the result of several past experiences. In 1976 the construction of the Furka-Tunnel has eaten up the entire budget after only 50 % of construction works have been finalised. Based on this experience the construction of the Vereina-Tunnel in 1991 was accomplished by a stringent and open cost controlling procedure. The positive experiences together with the extremely high risks and costs of the NEAT and the associated long construction time encouraged the installation of a similar controlling system. The national prestige character of the project and its link to international agreements has supported this decision.

Financial figures are expressed in prices of 1998. All inflation related increases are detected by the official NEAT price index and are financed by the Swiss parliament on top of the general loan for the project. Since 1998 the original load of 12.8 bn SFr. was continuously extended to the current final cost estimate of 19.8 bn. SFr. I.e. even when disregarding price changes the project is at a cost overrun of 55 %. Across all partial projects this is mainly due to safety and state of technology (25 %) and geology (11 %). Among the single projects the Gotthard axes is by far the most important cost block (estimated final costs 11.9 bn. SFr), followed by Lötschberg (4.2 bn. SFr.). The figure below presents the current cost structure and cost deviation analysis.

The transport performance is measured by the continuous Cross Alpine Freight Traffic survey (CAFT) every three years. The results are published by the Swiss office for Statistics (www.bfs.admin.ch). According to the Swiss Traffic Shift Act a maximum of 650’000 HGVs are allowed to cross the Alps – currently the number is 1263. The finalisation of the Gotthard is expected to substantially help meeting the envisaged goal.

The ex-post assessment for the Lötschberg axis is currently conducted since it is under commercial operation since December 2007. Details about this are not available so far.
4.4.3 Inputs from the ex-ante – the need for harmonisation

4.4.3.1 A common modelling platform

Given the relevance of demand forecast, the project appraisals would probably take advantages by relying - at least for some general aspects - on a common strategic forecasting tool. If the same modelling tool is used to provide demand projections for alternative projects, the comparability of results is much higher, even though it should be taken into account that many other parameters used in the applications of the same model can diverge.

However, modelling tools often benefit from being built and calibrated for a specific application, geographical context (country, region, etc.) and/or around a particular policy problem (pricing, investment, regulation, new technology, etc.). Therefore claiming that one specific model is always preferable in any context would certainly be unfair. Furthermore, demand forecast for transport infrastructures offers often the opportunity for methodological improvements and the selection of a specific model could impede more sophisticated applications and slow down progresses.

It seems more preferable from a methodological point of view, and also more realistic, to improve demand forecasts by defining a common platform for the modelling tools supporting projects demand projections.

The main pillars of the common modelling platform for demand forecasting could be the following:

- **Appropriate scale.** The models should handle all relevant demand in geographical terms, which means taking into account the traffic in the region(s) where the project is located but also the international flows (often accounting for a significant share of expected demand). Additionally, a correct geographic scale is needed to simulate appropriately alternative routes that demand could choose. If this condition is not met, demand forecasts can be either underestimated because some demand is missing, or overestimated, because alternatives are not considered.

- **Multimodality.** In many circumstances, demand can choose between alternative transport modes and therefore competition from each available alternative have to be considered. The models should simulate all relevant modes available to transport demand potentially attracted by the new infrastructure. All modes and intermodal solutions should be considered at the same time, according to the concept of “trans-European intermodal network”. This requisite is especially important because the market response of competing services (e.g. reductions of tariffs) has been often a major cause of overestimation of demand.
• **Segmentation**: the models should distinguish basic segmentation of market for demand/supply confrontation. Segmentation is often a matter of data and can be actually be difficult to identify many segments, however at least a basic distinction between business and non-business or low value goods and high value goods is recommended. Furthermore, all relevant demand segments should be enabled to react appropriately on the policy initiative to be tested by the model. I.e. none of these segments should be encoded as a fixed load in the network links.

• **Consistency** between modelling parameters and evaluation parameters; models should be calibrated for a recent base year, with updated parameters (e.g. operating costs, tariffs, etc.) and, above all, the parameters should be consistent with those used in the economic valuation of the project. For instance, value of travel time is generally used in cost-benefit analysis to estimate project benefits, while within transport models value of travel time is widely used in route choice and mode choice algorithms. If values used in the models are different from those used in the evaluation, the coherence of the analysis is weakened.

Lastly, models outputs should be sufficiently disaggregated in order to allow the assessment of the project contribution to the different objectives. For many EU projects the European initiative must be combined with national and regional objectives. The expected outputs might encompass impacts on international, national and regional traffic, expected services performances (time, cost, tariff and eventually quality of services), environmental impacts divided into local and global impact, etc.

### 4.4.3.2 Common database

A second area of harmonization is the availability of a common database. Data plays a key role for projects appraisal as well for models from several points of views. First of all, the quality of data greatly affects the overall quality of the modelling and the appraisal. Even very advanced and sophisticated algorithms can fail to provide reliable results when input data is poor. Second, given the relevance of data on modelling and appraisal results, estimates built on different datasets can be hardly comparable. Independent demand estimations can differ significantly to each other just because the starting data is not the same. Third, data collection is often quite a time-consuming task, especially when sources are not known in advance. With a harmonised database, the evaluation framework at European level could be considerably reinforced and the database could become a common reference framework for partner countries.

The main components of the common database are listed here below:

• **Socio-economic scenarios**. All project projections rely on socio economic scenarios, and thus the provision of a reference data set for base year as well as for medium and long term horizons will improve both the ex-ante appraisal and the ex-post evaluation. Case studies have shown how it is indeed difficult to trace back the underlying socio economic, reference hypotheses. The example to be followed in this domain is the DG
TREN energy forecasts document that provides socio economic reference projections per country and economic sectors, which could be also used for transport.

- **Long distance flows.** Nowadays information on international flows is limited after elimination of border within EU. Transport network models use a large amount of data and most of it necessarily concerns local conditions. However, models supporting the assessment of large projects also need data at a larger scale (i.e. national, international): this kind of data is the one whose availability could be more helpful. In particular, a key input for demand projections is the amount of long distance traffic, especially international flows, since this share of demand is often significant for large projects. This means current and projected matrices of trips/tonnes moving between European regions. If a reference source for this kind of information were available, one important driver of demand forecasts would be under control, either because an accepted source is used or because deviations from such source could be detected.

- **Common reference scenario for long distance demand projections at the EU level.** Evaluation studies generally produce their specific forecasts based on ad-hoc analyses and modelling applications. While for local traffic, forecasts are generally built on the availability of specific information on regional development, population growth, etc., for long distance and international traffic estimates are often derived from external sources, mainly EU scale models and studies. The identification of reference projections for the evolution of transport demand at the European level could improve demand forecasts from several points of views. It would provide an accepted scenario at least for international transport demand trend, and furthermore, would take into account key exogenous elements at the strategic level: European Transport Policy, infrastructure development, energy price, cost of competing modes, etc. All these elements are often quite uncertain and significantly contribute to the overall uncertainty of demand forecasts.

- **GIS network reference.** GIS information is a domain where important improvements have taken place and should be better used for transport modelling at a time when transport information is regressing in many domains and for O/D flows in particular. Reliable network attributes such as speed, density, and eventually capacity stemming from physical characteristics, are essential for evaluation of transport needs. Such attributes are rarely checked in the network description and generate differences in evaluation results and appraisal of needs.

**4.4.3.3 A common policy context**

The evaluation of infrastructure investments will depend on the specific policy context (which cannot be limited to the policies directly related to the project) and on the particular assumptions made about cost evolution of different modes. As shown by the cases studies, the policy context influences the impact of the investment and sometimes specific measures are even implemented in order to increase the expected impact. Therefore in order to reduce uncertainties, the actual
and future project context must be clearly defined in a common reference scenario. A first step in this direction is the definition of policy objectives and measures.

Policy objectives are often formulated in qualitative terms that need to be translated in quantitative terms whenever possible. However, it is always difficult to assign a quantitative objective to a single policy measure, considering that they are normally not independent one from the others. A definition of a check list of policy measures and objectives and a framework of the interactions between these objectives and measures will help to show policy measures/objectives which:

- complement or reinforce each other;
- contradict each other: for example, environmental objectives might go against an economic objective of performance and such contradiction will not only be solved with reference to global assessment of socio-economic impact for the society.

A common policy reference scenario

The definition of quantitative objectives requires the definition of a transport reference scenario, in order to benchmark the policy objectives. The definition of a European reference scenario should explicitly include assumptions on the European policy environment: EU directives will be more and more influencing for national transport regulations. This is particularly clear when looking back at what happened in the past 15 years for all modes of transport.

The regulatory context needs to be more carefully considered: competition between modes and routes as well as evolution of transport prices and costs are all factors that can significantly affect the demand development. It is today clearly accepted by European countries that the EU puts in place initiatives for transport regulation in order to guarantee free access and avoid competition distortions, which are basic market principle of EU. Furthermore, the EU area of intervention is presently extended also to infrastructure charging and environmental protection. The European initiative is consequently predominant for interregional and long distance transport. A better knowledge of the evolution through time of the policy context will then certainly help in improving traffic forecast.

Stakeholders involvement and social acceptability

For many European projects, particularly large strategic investments which encompass large geographic areas, the European initiative must be combined with national and regional objectives.

This requires both to keep stakeholders, citizens, and general public informed since the early stage of the project about the expected outcomes and take into consideration costs and benefits for different groups. Providing well organised information may help in overcoming some of the difficulties and promote public involvement. The lack of public involvement tends to polarise the debate, groups that are left without information tend to shoot down the project. Participation can
bring local knowledge that can improve the design and appraisal of options, as well as help identifying mitigation measures to better address people’s real concern.

The decision making process can be improved through the formulation of outputs indicators for different families of stakeholders, as for instance the SE Matrix suggested by RAILPAG (EIB, 2005).

### 4.4.4 Use of evaluation results

#### 4.4.4.1 Dissemination

Ex-post evaluation is of primary relevance, since it demonstrates how well a scheme has delivered its expectations and the main reasons for significant deviations. If a project has fallen materially short of expectations it is important for this to be made clear, with an indication of what went wrong in terms of, for example, flawed forecasting, unforeseeable external events, or weaknesses in design.

This should be made clear to the general public and not only to the policymakers, for two main reasons:

1. democracy: reporting what “tells a story”, why and where the project fell short of or exceeded expectations;

2. education: by giving publicity to the real achievements of the projects, incentives for better and more accurate ex-ante analysis are provided.

In order to achieve these objectives it is crucial that presentation and dissemination of the evaluation’s outcomes are as wide as possible. It is important to ensure and to communicate that ex-post assessments are not an instrument to blame the responsible planning authority, but to create a decision basis for similar future projects.

#### 4.4.4.2 Feedbacks to risk analysis

As it has been stressed, ex-post evaluation cannot be dissociated from ex-ante evaluation improvements. These are two facets of the same decision process, which aims at being consistent from economic, social and political point of view. Systematic ex-post evaluation is a critical learning devise and a prerequisite for building capacity and skills to improve the selection and management of future large investment projects.

The scope for systematic use of transport project evaluation and the data it provides is, among others, to provide a pool of information on the lessons that appear to follow from comparisons of projects outturns with forecasts, and the possible explanations for the differences. These may help to improve the understanding of appraisal generally, and of modelling and forecasting in particular.
Furthermore, ex-post evaluation data should feed into future decision making, in order to really enable the ex-ante evaluation procedure to be fine tuned through an ongoing feedback process between the operating results of existing infrastructures and the assumptions used to evaluate new capital expenditure decisions.

The basic evaluation required for accountability purposes may incorporate enough data on costs and demand deviations to build up a database to indicate how they varies in systematic ways across different types of schemes. Besides helping to make more realistic estimates in the future (e.g. reference forecasting) and therefore improve the ex-ante appraisal, ex-post evaluation can also be extremely useful to take corrective actions and to build confidence in the appraisal process.

4.4.3.2.1 Reference forecasting

Risk analysis raises the question of where to look for relevant distributions of parameter values. One possible approach is the so-called “Reference Forecasting”, i.e. taking an ‘outside view’ of the project by placing it in a statistical distribution of outcomes from a class of similar projects. In this perspective, the introduction of systematic ex-post evaluation can be extremely helpful in creating a set of credible data on type and size of discrepancies between ex-ante estimates and ex-post results. Data from past or similar projects elsewhere can inform future estimates and suggest best available approaches on demand forecast, costs etc. And the set of collected data will constitute an important input to the risk analysis, helping in establishing probability distribution for selected variables.

When the idea to use past experience to derive the distribution of parameter values is accepted, reference forecasting is a methodological approach proposed to do this in a systematic way. It requires the following three steps:

- the identification of a relevant reference class of past projects, sufficiently broad to be statistically meaningful without becoming too generic;
- the determination of a probability distribution of the outcomes for the selected reference class of project;
- a comparison of the specific project with the reference class distribution and a derivation of the ‘most likely’ outcome.
4.5 The contribution of a EC supporting team

The progressive approach outlined in the previous chapters will highly benefit from the support of a EC dedicated team that will be in charge of collecting and capitalise ex-ante projects documentation, provide harmonised inputs for projects appraisal, collect information on projects monitoring and ex-post evaluation. The team will act as an interface between academic studies, research projects and practice of project appraisal as well as a centre of diffusion of results and documents to the public.

The process of collecting data and information from both inside the EC and the institution and organisation in charge for project appraisal and evaluation outside the EC should be designed as an incremental activity that will grow through time together with the collection of information, documents and data. The mission of the unit should be to identify and disseminate the lessons learned from experience and frame recommendations drawn from evaluation findings.
The specific tasks of the team include:

- **Collect and capitalise project documentation.** A weak point of the evaluation process pointed in the case studies is the frequent changes over time of the institution or organisation in charge of evaluation, within or outside ministries. This implies that there is no “memory” of the appraisal process, which among other things makes it very difficult to perform ex-post evaluation. An important task of the team would be to define and check the documents which characterise the different steps of ex-ante appraisal and ex-post evaluation, capitalise such documents and guarantee public access to the information.

- **Provide harmonised inputs.** The team could provide to the relevant database, starting with the information already available at the EC on actual and forecast socio economic indicators, outcomes from the models like long distance traffic, reference scenarios for EU policies and investments etc. As far as modelling is concerned, the team could concentrate expertise on modelling with the support of a scientific committee from academic world. Another area where the team could play a role is in supporting the ex-post evaluation by providing tools and approaches which can help in minimising the evaluation costs.

- **Construct a database on past projects.** A great help to increase the information available on past projects would come from the construction of a database where data on all projects submitted to EC approval is stored and updated. In such a database, information would be classified according to several relevant dimensions like the type of project, its size, the region etc. For instance, in the light of the critical role played by the assumptions regarding the project costs, it would be very useful to collect data on single cost components, their ex-ante assumptions and their (ex-post) actual values. A statistical analysis carried out on this information could investigate the role of single elements on the discrepancies found on total project costs, e.g. additional expenditure for environmental mitigation, delay in the construction, etc. For each element (concerning costs as well as other key parameters affecting demand appraisal like fares), the statistical distribution of the discrepancies could be estimated and made available as benchmark for future assessments. Of course, such a database should be continuously updated with elementary data and therefore also statistical distributions should be periodically revised. Furthermore, the results of the ex-post evaluation of large infrastructure projects within the EC domain could be combined with other existing sources of information on projects performance.

- **Establish minimum requirements.** While the team should support the decentralised project assessment and evaluation one of its tasks that can be also establish some minimum requirements for projects entering into the TEN pipelines. Being part of the

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26 It’s worth noting that detailed information on cost components could also be used to estimate average costs that could work as reference for a first analysis of the reliability of the costs used in the assessment of new projects. When large differences with respect to the average arise, solid justifications could be asked.
large infrastructure investments in Trans-European Networks is granting a project with two types of advantages: the first one is financial and the second deals with the strategic objectives of the TEN’s, being part of them de facto implies attaching an extra-priority to the projects and could help in getting the project started.

- **Disseminate results.** The supporting team would eventually collect the project relevant documentation from the overall project cycle and made it available to other projects, stakeholders and concerned groups.

The team should have a progressive approach, starting from providing data already available, and collecting information on past experience. Its capability to support the project appraisal will be built on the accumulated experience and information and data collected. It is important for the acceptance of the supporting team to ensure and to communicate that ex-post assessments are not an instrument to blame the responsible planning authority, but to create a decision basis for similar future projects. In particular, the supporting team should analyse cost or performance deviations by different classes of reasons varying by the level of control the planning unit could have had.

A preliminary list of minimum requirements of projects for being part of the TEN’s pipeline should at least include:

- full availability of projects relevant documentation;
- compliance of modelling tools applied for demand forecast with the established requirements,
- benchmark of costs and benefits against reference class forecasting;
- comprehensive project appraisal including all the relevant steps (economic, financial, environmental and risk analysis);
- project should undergo public hearings to allow stakeholders and concerned groups to voice criticism and support;
- project monitoring and plan for independent ex-post evaluation.

### 4.6. Energy and transport projects: differences and similarities

#### 4.6.1 Comparing energy and transport projects

The major difference between transport and energy, and in particular the electricity transmission sector, is the fact that the electricity network is of supranational nature. The European electricity network has currently a structure which is very similar as two decades ago, because of the few investments realised in network expansion in the last 20 years. However, the network utilisation is very different and leads nowadays to very important (potential) congestions, especially in specific areas. In the last ten years, a decrease of cross-border net transfer capacities was observed that can be explained by a stricter adherence to the n-1 security criteria rules and by a
high increase of national and international electricity traffic. The electricity grid situation is characterised by a high volatility of electricity exchanges.

In the field of project evaluation, a major difference with the transport sector is the difficulty of assessing the increase of demand and the benefits of network operators. While analysing similarities and disparities in the energy and transport sectors, a first set of project assessment items (see following table) can be identified and discussed.

Table 4.1 Comparative overview of main characteristics of transport and energy projects

<table>
<thead>
<tr>
<th>Sector</th>
<th>Transport</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>Many, heterogeneous</td>
<td>Few, homogeneous</td>
</tr>
<tr>
<td>Demand</td>
<td>Many, heterogeneous</td>
<td>Many, homogeneous</td>
</tr>
<tr>
<td>Funding</td>
<td>Public</td>
<td>Private</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Many</td>
<td>Few</td>
</tr>
<tr>
<td>Expected indirect benefits</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

The table above includes the structure of supply and demand, the usual source type for funding large infrastructure projects, the abundance of project alternatives and the expected indirect benefits of projects in the sector considered. As an example, the energy supply is characterised by a small number of actors in comparison with the transport sector where several modes exist. This is the case especially in the electricity transmission sector, where the supply is very homogenous, constituted by a single electricity network owned and operated by a few number of actors.

This homogeneity is also found on the overall energy demand side, but is combined with the higher number of actors representing the energy consumers (industries, tertiary sector, residential sectors, agriculture, etc.). As a result, transport projects face higher uncertainty and risks that the ex-ante project evaluation should take into account.

On the funding side, the main source of funding for transport projects is public, although public-private partnerships are a growing trend. Energy networks are funded through mainly private capital and are owned by the grid operators. The source of funds eventually affects the rate of return required by a project: projects funded by public funds tend to require a lower return rate than projects funded by private capital, which have to compete in profitability terms with other options for capital investment and the financial markets in general.

While many alternatives can be considered to a given transport project, this is not the case in the energy sector, in particular in the electricity transmission sector, where except considering several route options for e.g. the construction of a new electricity transmission line, no further alternative exists unless considering the construction of a new power plant for example. In
addition, the construction of new electricity or gas network connection often faces strong public resistance due to environmental concerns, while transport projects often overcome those concerns exploiting the indirect economic advantages that they can bring. The expected indirect benefit from transport or energy networks is another major difference with repercussions in the evaluation process. Whereas energy grid projects tend to concentrate their impact on the improvement of the efficiency and/or reliability of the energy transport system itself (with usually some limited indirect environmental benefits and costs), a large part of the overall benefit from transport projects comes from the secondary economic impacts and the reduction of external costs (pollution, CO₂ emissions, accidents, etc.). This allows in many cases decision makers to give the green light to investments that would not be justified by a purely financial analysis.

Further common issues have been identified for both sectors, such as the policy priority of improving modal split (transport) and energy mix (energy), and the problem of external costs (e.g. social or environmental) which in both sectors are not fully reflected in evaluation methodologies yet.

A common challenge for the evaluation in both types of projects is the rising energy costs and, perhaps, more importantly, the volatility in energy and fuel prices. In addition, oil & gas supply dependency raises geopolitical/strategic issues, adding security of supply as an evaluation parameter.

A result of the combination of uncertainty and non-financial benefits in (mainly transport) projects is the difficulty to involve private capital in core infrastructure financing (public private partnerships). In parallel, long term policy priorities in the field of alternative technologies also face a bottleneck in the build-up of integrated systems of alternative fuel vehicles and the required infrastructure, delaying significantly the development of real private demand.

Finally, common assessment methodologies and approaches between both sectors are needed, as well as a more transparent decision making and an earlier consultation of further potential stakeholders. The main outcomes in relation with both energy and transport sectors are raised in the following part.

4.6.2 Lessons learned from case studies

The main problem encountered in the two EVA-TREN energy case studies was the unavailability of economic and financial figures, which is mostly lying on the fact that large infrastructure projects in the energy sector are in general conducted by private companies. This made the access to economic and financial information very difficult for both case studies. However a methodology has been proposed to re-evaluate ex-post the economic impact of such projects. This relies on scenario comparisons with a long term energy system model and a conjectural variations model, enabling to show the impact of a new interconnection on the marginal costs of electricity production in the (cross-border) energy system under consideration.
Demand analysis of both energy projects showed very low ex-ante ex-post deviations, which is explained by a lower level of uncertainties than in the transport sector. The electricity transmission grid constitutes indeed a network which is much more physically driven and less dependent than it is the case in the transport sector.

One out of both case studies included an analysis of uncertainties, however only relying on the n-1 security criteria, and considering a set of possible network improvement options. This criterion is however only used for the analysis of security of electricity supply and relevant for short term planning. Main critics formulated about this approach comprise the fact that the relevant data are once again the property of concerned network operators only, and that this criteria does not constitute an economic analysis, but only a technical one, limited to a specific (short) time period.

4.6.2.1 Data and models

In the electricity transmission sector, the data collection needs to be global, and not only focus on the project analysed, but take into account the whole European electricity transmission network. This is of crucial importance because of the strong sensitivity of the network, which is particularly relevant as regards the important congestion of the area Switzerland-Italy-France-Germany. As an example, a network expansion in an east-European country might have impacts on the whole network, including west-European areas of the transmission system. The elaboration of a European reference scenario is expected to theoretically improve project assessment in the electricity transmission sector, in particular by providing a common database for energy demand forecasts, of interest especially for cross-border network projects (harmonisation of data). It would as well permit to take into account European energy policies in addition to country-based forecasts, and should thus serve as a reference while comparing alternative scenarios. However, in regards with the congestion situation observed e.g. in Germany, Italy, Switzerland and France, the decision of a network expansion project is often taken independently of socio-economic scenarios, and therefore the impact of common databases and scenarios is lowered within the present situation of the electricity transmission sector.

The type of data needed and used in ex-ante analyses is of seasonal nature (1-year last curves depending on typical days, peak load and base load) relative to (cross-border) transmission capacity flows. This data is already existing and used, and will be in future published by the ENTSO-E, new structure resulting from the merging of the UCTE (Union for the Co-ordination of Transmission of Electricity) and the ETSO.

The most widely used modelling approach for the calculation of transmission flows in the electricity sector is the PRIMES model and its variations. These are global simulation models calculating a static equilibrium between energy supply and demand, taking into account energy demand and supply technologies and pollution abatement technologies. It includes a detailed representation of the European electricity and natural gas grids enabling the analysis of network reliability issues. In comparison with transport, it is important to keep in mind that the electricity transmission sector is considerably more physically driven, and not so strongly influenced by external behaviours. It is added that the multiplicity of models and algorithms in electricity
transmission planning makes it difficult to match different flow data from different models, but the competition between models tends to improve the overall methodological approaches. The improvement of forecasts thus implies the improvement of already very complex network simulation tools used by e.g. the UCTE.

4.6.2.2 Stakeholders’ involvement, transparency and acceptability

Improving transparency and continuity of the decision making process of projects is a necessity for increased acceptability. It should integrate a provision of the relevant documentation and public debates at an early stage of the project in order to face the strong public opposition occurring in energy network infrastructure projects. Moreover, it is a prerequisite to a better evaluation, taking into account project mutations over time such as the stakeholders involved, the robustness of analyses conducted and the evolution of data.

The problem of stakeholders’ involvement into the decision making process is also a significant problem in the electricity transmission sector. This complex issue is often driven by the changing of project situation and objectives over time. As an example of the paradox arising with this issue, a high involvement of a large number of stakeholders is needed for the decision making process and acceptability of projects but increases overall project costs in the meantime. Further points constitute strong similarities with the transport sector, as e.g. the need of public debate before project start, of process transparency, the scale differences between the technical project and the land use, the importance of the political framework in which the project is implemented, and finally the importance of considering not only the phases before and after the project, but also during the project, as project duration often lasts about one generation time and thus cannot be neglected.

In comparison with the transport sector, the strong public opposition and the weaker acceptability is explained by the absence of real return for citizens from the electricity transit situation. However, concerning public awareness before the start of electricity network expansion projects, environmental studies are very often published before the project starts but it is not a guaranty as it does not necessarily accelerate the decision making which remains very long. Finally the impact of an improved procedure for the decision making is expected to remain quite low regarding the already existing rather high transparency and continuity.

4.6.2.3 Specific European policy issues

The assessment of European policy measures within project evaluation should be considerably improved while taking into account comparison scenarios. In the field of context analysis, which is particularly relevant for the electricity transmission sector, interdependencies must be and are already generally widely considered during project evaluations. However, the private ownership of electricity network operators makes planning process at European level very difficult to implement.

The electricity grid is by essence supranational and there is therefore a need of general coordination at the European level. The lack of coordination currently existing implies that
national specificities are often not fully considered, thus leading to a less effective electricity transit than planned. The creation of a EC supporting team for energy network infrastructure projects would guarantee, through its expected neutral status, a better involvement of stakeholders, which could lead to an improved and more continuous decision making process. This might be very helpful in elaborating an agreed common evaluation methodology for projects, providing some common tools and reference data for project assessment, and finally providing output indicators for the different categories of stakeholders concerned by the projects.

Most of other statements related to the EC support team for project evaluation discussed for the transport sector are also relevant for electricity network expansion projects. Thus, there is a real need for a cycle in project evaluation between ex-ante and ex-post assessments, which could be encouraged by such a team, contributing to provide some references to be used (data, scenarios) and foster independency in evaluation processes.

4.7. Recommendations for methodological improvement of ex-ante and ex-post evaluation

The following paragraphs presents the main recommendations aimed at improving the methodology for ex-ante and ex-post evaluation of large infrastructure projects in the energy and transport sectors.

4.7.1 Consider the whole project cycle

The “project cycle” has different stages, from preliminary appraisal to ex-post evaluation. In the appraisal stage, we recommend an approach, comprehensive and adapted to the level of debates and analyses that takes place at different stages, with more global assessment in the beginning and more complete and more detailed assessment at the end, including economic review. Decisions are clearly path dependent, and assessing conflicts continuously throughout the decision making process could contribute to resolve potential conflict before they become actual conflict. Stages should be integrated into the project cycle, so that the main issues are monitored systematically, thus enabling a better project selection.

This requires that interrelations between ex-post and ex-ante evaluation are taken into account since the beginning of the project appraisal. In this comprehensive approach, the ex-post evaluation should enable the ex-ante evaluation procedure to be fine tuned through an ongoing feedback process between the operating results of existing infrastructures and the assumptions used to evaluate new capital expenditure decisions.

The whole evaluation process must develop in a smooth way since changes of objectives or contestation, which are legitimate, might influence the results of evaluation, ex-ante and ex-post. Possible changes and implementation problems must also be considered in the evaluation process definition.
4.7.2 Adopt a dynamic approach to ex-ante appraisal

The decision making process of large infrastructure projects takes place during a period of time which is a “very long” one. Objectives might change during such a period and the time dimension of the decision process must be integrated, managed and controlled. Consequently, appraisal cannot be made once and for all, but must adapt to such different stages, with more detailed analysis when the project is defined. This asks for the establishment of a clear design of the decision making process for large infrastructure projects of EU interest. A dynamic use of ex-ante evaluation, carried out with different levels of detail each time the project is subject to modifications and adjustments, can represent an extremely useful approach to highlight the essentials matters and to ensure an adequate basis for decisions in the course of the process shaping period. Changes of objective will be in such framework registered with their possible impact on expected outputs, and consequent adaptation of tools. Delays in decision process and implementation will be considered as part of such process with an analysis on how such delay might positively or negatively affect the expected impact of the project.

4.7.3 Use a progressive approach to environmental analysis

Despite the formal recognition of their importance, environmental priorities still play a marginal role, with no real influence in the decision whether or not the project should be implemented. The capability of Environmental Impact Assessment (EIA), when carried out at the very beginning of the project appraisal, to influence the project technical solutions adopted in order to minimise the environmental costs to society, as well as to organise the public debate around the project and contribute to reach the consensus should be extended also to the whole assessment procedure. By proceeding in parallel with a dynamic ex-ante appraisal and a progressive environmental analysis, reappraising the project each time it is modified in order to mitigate environmental impacts, and re running the environmental analysis each time the project is adjusted will guarantee for a positive dialogue between environmental and social issues.

4.7.4 Perform quantitative risk analysis

The evaluation process necessarily entails a forecasting exercise: assumption on costs, benefits and effects has to be done before they are realized. A quantitative risk modelling a subsequent plan for risk management and mitigation are of paramount importance for improving the performance of large infrastructure projects. The quantitative risk assessment involves the selection of the variables to which the project design is most sensitive, the assignment of a probability distribution to the selected variables and then determine the effect of varying simultaneously the variables on the project performance indicators (NPV - IRR). Since the definition of probability distribution is the cornerstone of a meaningful risk analysis and, at the same time, is often the most challenging task, it is worth exploring possibilities to address this issue. Reference forecasting is suggested as an important tool for generating sound probability distributions.
4.7.5 Monitor project development

In the progressive approach recommended along the whole project cycle, the continuous monitoring of projects implementation represents the starting point for a successful project cycle approach based on learning from past experiences. The monitoring process should look at all factors that may potentially affect the project feasibility, bearing in mind that the implementation of large infrastructure project may last several years, during which many things may happen. This means that the checklist of the “monitoring” system that must be put in place should include not only investment costs, but also the socio economic context, the transport context, the expected impact as regards transport evolution of demand, supply and environmental impact of the project.

4.7.6 Adopt risk management and mitigation strategies

Scope of the “risk management and mitigation” is to identify possible strategic answers to the more critical items identified through the risk analysis. We recommend risk planning to identify how the various risks can be managed and by whom.

4.7.7 Systematically perform ex-post evaluation

We recommend a systematic use of ex-post evaluation. The ex-post evaluation increases transparency by giving evidence to the effectiveness of the investments in relation to the reached financial, economic, environmental and social objectives; provides elements to improve the ex-ante assessments of future interventions; collects relevant information about past projects to be used as reference class forecasting; and finally, by giving publicity to the real achievements of the projects, provides incentives for better and more accurate ex-ante analysis. Concerning ex-post evaluation we recommend the following.

- Start the planning of the evaluation process at the stage of the project design together with the definition of the analytical framework, which produces a requirement for the data collection activities.
- Maintain all the project documentation available, in order to provide feedbacks for the improvement of ex-ante techniques performance.
- Collect ex-post information about projects performances, and compare the observed outputs and outcomes with those expected in the appraisal stage.
- Identify the “after-without” the scheme (called the counterfactual situation) to be compared with the “after” opening.
- Identify and quantify the discrepancies between the ex-ante appraisal and the ex-post results and assess as far as possible what caused the discrepancies, distinguishing
between endogenous or exogenous factors. While the latter are hardly predictable and outside the control of the project management, the former might be included in the ex-ante analysis to reduce the related risks.

Concerning costs evaluation and undue optimism, a specific requirement of ex-post evaluations should be to investigate the methods used to obtain costs and the reasons behind the divergences between expected and actual costs. In order to progressive improve the cost estimate, we recommend to develop country based database where information would be classified according to several relevant dimensions, and to use the statistical distribution of the discrepancies as benchmark for future assessments. Looking at the reasons behind the difference between the observed outcomes and those expected in the appraisal stage, it might be extremely useful to examine aspects of the development and implementation of the project from the decision-making process point of view (process evaluation). Finally, in order to give a measure of the effectiveness of the investment, the evaluation should be conducted in the same manner as the ex-ante economic appraisal and the actual economic performance indicators, to be compared with the expected ones.

4.7.8 Use harmonised models and data

Different transport infrastructure projects should be made comparable on the basis of the same assumptions at least from the point of view of international flows. Given the relevance of demand forecast, we recommend to define a common platform for the modelling tools supporting projects demand projections. The main pillars of the common modelling platform for demand forecasting at the strategic level could be the following:

- appropriate geographic scale is needed to take into account also the international flows (often accounting for a significant share of expected demand) and to simulate appropriately alternative routes that demand could choose;

- multimodality is especially important because the market response of competing services (e.g. reductions of tariffs) has been often a major cause of overestimation of demand;

- the models should distinguish basic segmentation of market for demand/supply confrontation;

- consistency between modelling parameters and evaluation parameters; v. finally, models outputs should be sufficiently disaggregated in order to allow the assessment of the project contribution to the different objectives.

A second area of harmonization is the availability of databases. Data plays a key role for projects appraisal as well for models. With an harmonised database, the evaluation framework at European level could be considerably reinforced and become a common reference framework for partner countries. We recommend to provide:
• a reference database of the main socio economic variables for base year as well as for medium and long term horizons;

• long distance flows (current and projected matrices of trips/tonnes moving between European regions);

• a common reference scenario for long distance demand projections at the EU level, taking into account key exogenous elements at the strategic level (European Transport Policy, infrastructure development, energy price, cost of competing modes, etc.);

• GIS network reference (reliable network attributes such as speed, density, and eventually capacity stemming from physical characteristics).

4.7.9 Make maximum use of evaluation results

First of all, we recommend that presentation and dissemination of the evaluation’s outcomes are as wide as possible, for two main reasons: i. democracy, and ii. by giving publicity to the real achievements of the projects, incentives for better and more accurate ex-ante analysis are provided.

Secondly, the scope for systematic use of project evaluation is, among others, to provide a pool of information on the lessons that appear to follow from comparisons of projects outturns with forecasts, and the possible explanations for the differences. We recommend:

• to use these lessons and data to improve the understanding of appraisal generally, and of modelling and forecasting in particular, and to really enable the ex-ante evaluation procedure to be fine tuned through an ongoing feedback process;

• to build up a database on costs and demand deviations to indicate how they varies in systematic ways across different types of schemes;

• to use data from past to inform future estimates (e.g. reference forecasting) and

• to use past experience to derive the statistical distribution of parameter values as an important input to the risk analysis.

4.7.10 Establish a EC supporting team

We recommend the identification of a EC supporting team in charge of collecting and capitalise ex-ante projects documentation, provide harmonised inputs for projects appraisal, collect information on projects monitoring and ex-post evaluation, establish minimum requirements for projects assessment and evaluation, and disseminate results. The supporting team should have a progressive approach, starting from providing data already available, collecting information on past experience and promote project implementation monitoring. The team capability to support the project appraisal will be built on the accumulated experience and information and data collected.
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