NOTE

The exceptional nature of the introduction of the Channel Tunnel has led Belgium, Denmark, Spain, France, Ireland, the Netherlands, the United Kingdom and Switzerland to participate in a joint research programme on the socio-economic effects of this infrastructure as part of COST 317. This project, which was launched in 1991, is extended beyond the normal three years until 1995 to make up for the delays in the opening of the Tunnel.

The following pages form the interim report of COST 317 ; they reflect the work carried out by the national delegations and the discussions held during the various meetings of the Management Committee. Owing to the variety of authors they make no claim to unity in style or perfect consistency in analysis. They therefore reflect the diversity of approaches and variety of cultures which have marked these years of joint work.

This diversity does not, however, signify opposition. A wide consensus has emerged on the very purpose of the project, the analyses of the relationship between major transport infrastructure and socio-economic changes.

Finally, this variety is a consequence of the diverse practices of the various countries in the methods which they use for apprehending the consequences of transport infrastructure. These methods and current practices are a long way from being permanently fixed ; they are still developing today, which means that this report is a provisional reflection of a changing situation rather than a definitive response to a question which remains largely open.

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SUMMARY

INTRODUCTION

COST 317 is intended to specify the relationship which may exist between the introduction of a major transport infrastructure (the Channel Tunnel) and its consequences on the socio-economic changes to the surrounding area and to propose where possible a method for detecting and evaluating these changes. However, the work carried out has shown the difficulties inherent in this question which are easily understood once the scientific context is taken into account. This leads to a proposal for a new approach to study and to evaluate the socio-economic effects.

This work, therefore, reflects the doubts of the delegations who have met regularly, in that it is uncertain whether the nature and importance of these effects can be clearly apprehended at the close of the project, but the work also raises great hopes by clearly posing the questions underlying this research.

1. The objectives of COST 317

COST 317 was launched by France in 1991, under the leadership of Bernard Gérardin. The exceptional combination of two factors fully justified the project : i) the existence of numerous research projects on the fundamental effects of major transport infrastructure which came to some very clear conclusions and ii) the completion by Anglo-French private capital of a structure of exceptional size and importance, ie the Channel Tunnel. This was a unique chance to try to identify any changes to the socio-economic environment attributable to this new transport infrastructure.

The COST 317 project set itself the task of identifying relevant methods and their application to the *ex post* socio-economic evaluation of the Channel Tunnel and attempting to generalise to other major infrastructure[1].

Four objectives were clearly set out in the proposal note

1. to compile an inventory of the European, national, regional and even intra-regional databases necessary to implement this evaluation ;

2. to identify the quantitative and qualitative variables to be integrated in these evaluation models ;

3. possibly, to define and initiate the construction of new databases ;

4. to draw any valuable lessons from the work carried out in the case of the Channel Tunnel with regard to applying the methods adopted to the evaluation of other major infrastructure projects.

[1] Note of 4 November 1993, reference COMTECH/5/94, VII/126/94

The construction of the Channel Tunnel was therefore an unmissable opportunity for conducting a study, even though studies already conducted in various countries already cast doubt on this very mechanistic view of a cause-and-effect relationship between major infrastructure and changes to surrounding areas which was identifiable by more or less tried-and-tested statistical techniques.

This question was already clearly expressed in the text on which the Technical Committee's decision was based :

"The socio-economic effects of infrastructure such as the Channel Tunnel are not restricted to the direct economic impact as seen in the development of the conditions of operation of the transport market in terms of prices and time and capacity saved. These effects which are apprehended by the traditional tools of economic calculation tend to underestimate the reality of the roll-on effects on economic development."

It is therefore easy to see why the objectives announced have been gradually reexamined as part of COST's work, given that knowledge "of the fundamental effects of major transport infrastructure" has been refined and considerable stress has been laid on the significance of the context in which this research has been conducted in the different countries.

1.1. Study of the effects

Since the 1960s in the United States and the 1970s in Europe, especially in France, questions have been raised over the consequences of the introduction of new transport infrastructure on economic activity in general and the organisation of surrounding areas in particular. These studies looked at examples of roads and motorways. They were mostly centred on a simple causal relationship : an attempt was made to measure the extra development or employment generated by the new infrastructure. Very quickly, however, it was noted that this way of reasoning could not continue given the conclusions reached by the studies which may be summed up as follows[2] :

- growth and jobs do not automatically follow the construction and introduction of a new transport infrastructure,
- the effects are very often tenuous and only appear after a long time and may not always be linked with certainty to the investment in transport,
- the effects are mostly commensurate with the potentialities (economic, tourist-related, human) of the regions served,
- finally, these effects depend to a great extent on the supporting measures taken by the local authorities.

It is thus easy to understand why some writers have even gone so far as to question the very concept of effects when applied to transport infrastructure[3].

2 See references at the end of the report.

3 See inter alia Jean Marc OFFNER, INRETS, PARIS

1.2. Pressure by political decision-makers

More profoundly, greater light has gradually been thrown on the reasoning behind research on the "fundamental effects of major transport infrastructure". Although there is no doubt that behind these numerous research projects there is the curiosity which encourages all scientists to gain a better knowledge of the area in which they conduct their research, the research is in the main an attempt to meet a request by political decision-makers who ask themselves three questions :

- Should this infrastructure be constructed or not?
- If the decision is taken to construct infrastructure of this type, what technical solution should be adopted and what route chosen?
- If it is decided to construct the infrastructure, what will be the consequences for the regions crossed and the activity of the country as a whole?

The question of effects has therefore initially been an aid to decision which attempts to go beyond the logic merely of transport and infrastructure capacities. The attempts to integrate the indirect effects in the cost-benefit analytical methods which serve as a basis for decisions is a good illustration of this concern.

However, faced with the cost of such construction works, political decision-makers have also wished to show that this major infrastructure was a boon to the community which went far beyond the area of transport. Is it not possible that such investment is a means of promoting economic growth, and even reducing the backwardness of certain regions more or less forgotten in terms of development? As we have already said, the question of measuring the effects has always preceded the question of whether such effects exist.

The more recent concerns to respect the environment and maintain a situation capable of allowing development which is sustainable in the long term have complicated the debate on the effects of major infrastructure. It is now necessary to be in a position to predict what will be the damage to the environment which a new infrastructure project may cause.

Behind the long-standing question of the effects of major infrastructure there are then the many and varied political contexts in which the infrastructure has been completed : France constructed the TGV essentially for reasons of transport capacity, while Denmark is constructing a fixed link to provide regional development and the Swiss Confederation sees the *Nouvelle Ligne Ferroviaire Alpine* [New Alpine Rail Line] as a way of unifying the country.

It would therefore be rather naive to wish to use a single method to answer questions which are by definition diverse.

2. The scientific context

The way in which the approach of scientists to this question has developed reveals the uncertainties over the use of methods. There is currently no agreement on definitions and the classification of the effects of major transport infrastructure or on the methods to be used.

2.1 A scientific area which is still little known

The diversity of the methods used in the various countries is a clear consequence of this scientific uncertainty. Just like the team charged by DG XVI with evaluating the potential effects of the Channel Tunnel on the European regions, most teams, instead of choosing a single method, prefer to use a mixture of methods to try to scan all the possible and still poorly identified areas.

Behind this wide variety of methods three main approaches can be distinguished : methods of evaluation based on the cost-benefit analysis, econometric approaches and empirical approaches.

- The first attempts at evaluating the effects of major transport infrastructure were made within the conceptual framework of the **cost-benefit analysis**. The reason for this is clear since the aim was mostly to evaluate the social utility of such a project. The advantages and disadvantages of the cost-benefit analysis are too well-known to dwell long on them here. The analysis is effective in the short-term for drawing up an overall picture of a situation for individuals or the community, although the assumptions on functions of utility are not always clearly explained and choices have to be made to weigh the various point of view. Although this type of method remains effective in a relatively limited number of specific cases, it cannot be the basis for an evaluation of the fundamental effects. What is more, it is totally dependent on the methods used for forecasting effects since it only values them and weighs them against other advantages or disadvantages.

- **Econometric approaches** have mainly sought to relate the variables governing an improvement in the supply of transport to indicators of regional growth. For transport variables use is made of savings in time or reductions in the generalised cost and investment expenditure. With regard to the regional aspect, models are found which include as variables regional product, international or interregional trade, different employment levels etc.

- Faced with these difficulties many researchers come back to **very empirical methods** to attempt to approach the effects of major infrastructure : all studies then become isolated cases which are often of excellent quality but can no longer be compared one to another due to the diversity of their approaches and area of interest.

2.2 The three ages of the study of socio-economic effects

The research conducted in the effects of major transport infrastructure has therefore moved through three ages : the ages of direct causality, conditional causality and finally new attempts.

The first type, which is based on the assumption of a direct link between the introduction of an item of transport infrastructure and the appearance of socio-economic effects, seemed to have been completely abandoned due to a lack of satisfactory statistical verifications ; econometric relationships have indeed been found, but there is no way of qualifying them and above all there is no way of attributing the difference noted to the transport infrastructure. Crucially, it has consequences in terms of economic policies which are now increasingly being questioned : a particular investment in transport does not bring equivalent changes to regions which are very unequally developed or which have very different specialisms. All economic research comes up against difficulties where it postulates that the structures of the model (and sometimes even the parameters) can be transposed from one situation to another.

Quite naturally, research then moved towards taking greater account of local features, assisted in this by a greater tendency to listen to theories on local development and the increased concern for respect for the environment. The talk was then, with regard to effects, of permissive conditions, support strategies, and even matching. The research in these new directions has not, however, produced a single body of definitions and methods.

Current attempts seek to take account of the discussion on complexity, by economists in particular. This argues that all major new infrastructure is introduced into a complex system, and this complexity is not only the result of our inability to take all the various factors into consideration but is a dimension of the social phenomenon studied.

However, in all these studies, sufficient account is not taken of traffic. Sufficient account is indeed taken in some models, but in a theoretical way. However, recent studies carried out with regard *inter alia* to the introduction of high-speed rail travel in France, show that an accurate knowledge of traffic prior to and following the introduction of the infrastructure studied can reveal the major socio-economic changes. The European Union has dealt with these matters in COST 312 and it is essential today that the recommendations arising from the project should be put into practice in the various countries involved.

2.3. *A priori* studies

Finally, this scientific area has the peculiarity of involving a large number of *ex ante* studies and very few *ex post* studies. This discrepancy is very fully explained by the political context underlying this wish for knowledge. Until the infrastructure is completed, information needs to be produced, either for the purposes of persuasion or to attempt to anticipate certain predictable consequences. Once the infrastructure has been completed, the studies are no longer necessary, since the only objective of the concessionaires is to ensure the financial viability of their investment and provide information which is sufficient for shareholders but not sufficiently complete for the purposes of genuine socio-economic studies.

The claims put forward in support of projects are mostly therefore unverified. Indeed, one of the difficulties faced by COST 317 is the availability of numerous predictive studies but a lack of studies analysing the effects of major infrastructure in service over a sufficient number of years.

The difficulties met in the construction of the Channel Tunnel which have led to delays in introduction of the service merely accentuate the problem faced by COST 317 and mean that it, too, is merely a predictive study, unless there is a clear U-turn on its objectives which have led to a progressive discrepancy between the initial COST timetable and the opening of the Tunnel.

3 Towards a new approach to socio-economic effects

Faced with this situation, it is clear that the COST project, with the limited resources at its disposal, and which is restricted to regular meetings between researchers to compare the various national approaches and experiences, cannot alone carry out a study of the socio-economic effects of the Channel Tunnel. Moreover, bearing in mind the timetable constraints, this study could only be prospective, or at the very most note the first consequences of opening.

The COST project has therefore set itself three objectives which may, as we shall see, help considerably in taking forward the questions posed above and unify the knowledge gained.

3.1. A redefinition of its purpose

Bearing in mind the discrepancies which have progressively occurred between the development and the construction of the Tunnel, COST 317 has given its attention to **all major infrastructure projects** in European transport : this includes all passenger and freight transport projects which as a result of their scope are intended to transform the conditions of transport between European countries. This would therefore involve projects in northern Europe, Switzerland and Austria and some French Alpine projects.

This choice is a result of the observation that the problems posed by these major items of infrastructure are essentially the same, the financial sums involved are on the same scale, and the methods used to evaluate their value are all equally uncertain.

The value of extending the subject of COST 317 to structures other than the Channel Tunnel is therefore to increase the effectiveness of the discussion and provide additional information with a view to the decisions to be taken in coming decades.

3.2. Critical analysis of the methods used

For this reason it has been proved essential to make an inventory of the various methods used or considered in the various countries. This inventory, which seems more or less complete, is an initial attempt at an evaluation since it throws a little light on three areas :

- government policies
- definition of the effects
- the techniques used.

To make a biological comparison, the analysis of the socio-economic effects of transport infrastructure is a diagnosis rather than a simple analytical technique, since, in order to be able to answer the question of effects, it is necessary to know :

- what are the objectives pursued by the States or the European Union : to reduce unemployment, stimulate local development, promote trade, reduce bottlenecks etc?
- what are the features specific to the locality?
- what is the information available or accessible at a reasonable cost and the associated methods which may be used?

Answers to the question of socio-economic effects will probably be a mixture of elements : depending on the practices, features specific to the locality, political objectives, a specific set of more or less complementary and more or less redundant methods will need to be used.

This position amounts to an abandonment of a mechanistic vision of the functioning of the social body, which would imply that a specific item of infrastructure always produces the same economic and spatial effects.

3.3. The need for an analysis of social functioning

This question of the socio-economic effects of major transport infrastructure finally refers back to the need for an analysis of social functioning. In our joint terminology which is largely shared by politicians and the public, an item of infrastructure has **"effects"** because it gives rise to alterations in the behaviour of individuals and groups, which ultimately lead to other ways of proceeding in, and other uses for, the surrounding area.

The lack of a joint paradigm largely shared by the scientific community, with regard to this social functioning, means researchers return in the area in question to being merely "clever odd-job men" since no theoretical construct is yet currently feasible and any such construct could not be restricted to transport only.

COST 317, by stressing very strongly the need to gain a full knowledge of the circulation of goods and persons, and not to restrict oneself to localised changes, can play a significant role. It should raise a general cry of alarm to alert national and European authorities, since in the coming years we very clearly run the risk of no longer having available quality information on this interaction, which is the key to understanding spatial transformations. This is due to two important changes which will eventually lead to the disappearance of information on circulation :

- the elimination of frontiers within Europe does away with customs sources on the traffic of goods and transport of persons,
- the concession of major structures to private companies is not accompanied by sufficiently precise specifications requiring companies to provide the information essential to governments with a view to taking new measures to programme transport infrastructure.

COST 317 has today reached the halfway stage : it has respecified its purpose by clarifying the definitions of socio-economic effects ; it has gathered together the methods used by the various countries and evaluated them on the basis of their area of effectiveness. It now remains for the project to specify as clearly as possible the conditions in which these different methods may be used, since it does not seem realistic to try to establish a single method : the variety of scientific contexts and government choices requires a more modest objective. It can be defined as the formulation of a protocal (e.g. commonly-agreed procedures within a consistent framework) or the specification of a 'standardized' set of analytical tools with which transport planners and policy analysts can use. This is perhaps the only realistic and at the same time effective way today to ensure that our understanding of major infrastructure continues to progress.

PART ONE : TYPES OF EFFECTS AND METHODS OF EVALUATION

Knowledge of the consequences of the introduction of major transport infrastructures raises three questions :

- The first concerns the aspects of economic and social activity which are considered liable to be modified ; this question leads on to a definition of the implicit or explicit objectives which the infrastructure has been designed to achieve.
- The second question, following from the first, is that of classifying the expected or hoped-for changes ; it causes us to refer back to the underlying theories which explain the relationships between transport and socio-economic development.
- Finally, the third question concerns the various methods that can be and are used to identify these changes, a point which will be dealt with in more detail in the second part of this Report, devoted to studies of procedures adopted in different countries to predict transformations which can be attributed to major infrastructures.

1. Identification of fields concerned

Standard methods of evaluation for transport investment projects focus on the benefit side on :

- time savings and journey quality improvements (e.g. comfort, frequency, interchange convenience) captured in the fare ;
- time savings and other benefits not captured in the fare (consumer surplus), either for users of the project or non-users (e.g. users of parallel roads which are decongested) ;
- savings in operating costs (again, either to operators or users of the project itself or to others affected).

When relatively small changes in these are expected to result from an investment project, a number of simplifying assumptions are normally made.

- the first of these is that there is no effect on the pattern of trip origins or destinations as a result of the improved accessibility (the "fixed trip matrix" assumption) ;
- the second (and related) assumption is that there is no effect on the property or labour markets.

One reason for abandoning these assumptions may be that the relative change in accessibility arising from journey time changes or reduction in interchanges is so great that there are likely to be significant transport effects which the conventional modelling assumptions are unable to reproduce. This feedback can be modelled through a full land-use transport model or through relatively simple adjustments made to the fixed trip matrix. On the other hand, changes in the property and labour markets may be a specific target of official policy, in which case they need to be identified for consideration alongside the transport benefits.

It is not normally considered proper to evaluate and score these benefits (increases in land values or reductions in unemployment**,** for example) on the same basis as the transport benefits, as this would generally constitute double-counting. In the case of land, increases in value can be considered (if scale economies are disregarded) as the capitalised value of uncaptured transport benefits. In the case of labour, it may be conventionally assumed that transport projects have no macro-economic effect - because government policy is assumed to be optimal in this respect or because the labour market is assumed to work perfectly at the national level - and that increased accessibility merely results in movements of labour to one locality at the expense of another.

However, it might be an object of explicit public policy to favour employment in some locations more than others, and therefore some value might be put on employment effects of a transport project which assists in this aim in respect of these effects over and above purely transport benefits. The value for money of these effects secured through the transport project should in this case be compared against other, perhaps more effective, ways of achieving the same objective. But the ability to achieve two objectives at once will result in some explicit or implicit weight being put on the non-transport benefits.

Although localized or regional development benefits are usually expressed in terms of employment, they may also be referred to in terms of gross regional product, value added, income or income-related social indicators. In addition, accessibility itself (in terms of point-to-point access times) may be an explicit object of policy, particularly in the case of regions or urban centres which are noticeably isolated. And, of course, increases in land values may be treated differently (notably in an urban context) according to their location, as this might be thought to be related to the job-attracting potential of the area itself and, through secondary effects in the labour market, a maintenance or improvement of incomes and employment over a wider area.

In some European countries, explicit considerations are also given in project appraisal to the economic effects of changes in road safety (accident prevention) and impacts on social and economic cohesion.

Other effects which may have an impact on policy objectives, but which do not arise through an effect on accessibility, are usually identified in the case of large projects. These tend to relate to environmental impacts, either :

- (usually) **negative impacts on the visual environment** (but which may include the opportunity to improve derelict or polluted land which otherwise would not be financeable out of public funds) ;
- **a reduction in emissions** (usually), e.g. from motor vehicles as a result of a rail project. This may refer to **noise** as well as CO_2 or other **gases.** The diversion of flows of dangerous or heavy vehicles (e.g. across the Alps) may also be a consideration, and an objective in terms of the numbers of such vehicles may be set (although, as in the United Kingdom, an explicit value may be given to these for the purpose of subsidizing alternatives).

Where **freight** is a particular concern, it may be desirable to incorporate explicit modelling into the assessment.

Large transport projects, either by virtue of their size or of their being part of a network, tend to have comparatively large external costs or benefits. It is in taking account of these external effects that "large" projects often distinguish themselves from "small" ones. By their nature, there are comparatively few large projects, and procedures for their assessment may be tailor-made.

2. The effects

2.1. Effects of transport infrastructures

It is important not to confuse the effects of transport infrastructures with the instruments with which they are implemented. There is no pre-defined theory for analysing the effects but they may be divided into two main categories : **short-term** and **long-term** effects. A further distinction is introduced by Piet Rietveld, who speaks of **additive** and **redistributive** effects.

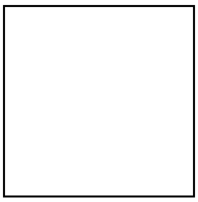
Redistributive effects mean that no increase in overall production is observed. They involve relocation of activities or changes in conditions of endogenous production.

Additive effects mean that there are gains in production. These fall into three categories :

- **immediate effects** arising from a cut in generalized transport costs and thus an improvement in productivity ;
- **benefits of reorganization**, or secondary benefits, with economies of scale enabling a bigger market to be exploited by a drop in the cost of access to the market and integration of the markets ;
- **stimulative effects** which mean increased competition between regions, with firms obliged to stick to the "learning curve" and thus increase their productivity.

This distinction does not, however, incorporate psychological aspects, frontier effects or environmental effects which cannot be expressed in monetary terms.

The relationships between transport infrastructures and spatial development are illustrated in a diagram by Rietveld[4] :



Link 1 shows that an improvement in the transport infrastructure can lead to a drop in transport costs, with shorter distances or higher speeds resulting in a reduction in the number of vehicles and drivers for the same level of service, a cut in petrol consumption, etc.). This in turn means an increase in the productivity of firms, either directly (link 3) or because of growth in transport flows (link 2) and greater accessibility promoting new locations (link 5).

All these effects combine to affect the levels of development and/or relocation of firms and households (links 6 and 7). This is a limited interpretation, however, since it assumes that all the effects are generated by the infrastructure and this is not affected by the changes which it has generated.

4 Rietveld P., "Spatial economic impacts of transport infrastructure supply", Vrije Universiteit, Faculty of Economics, Amsterdam, December 1992, 27 p.

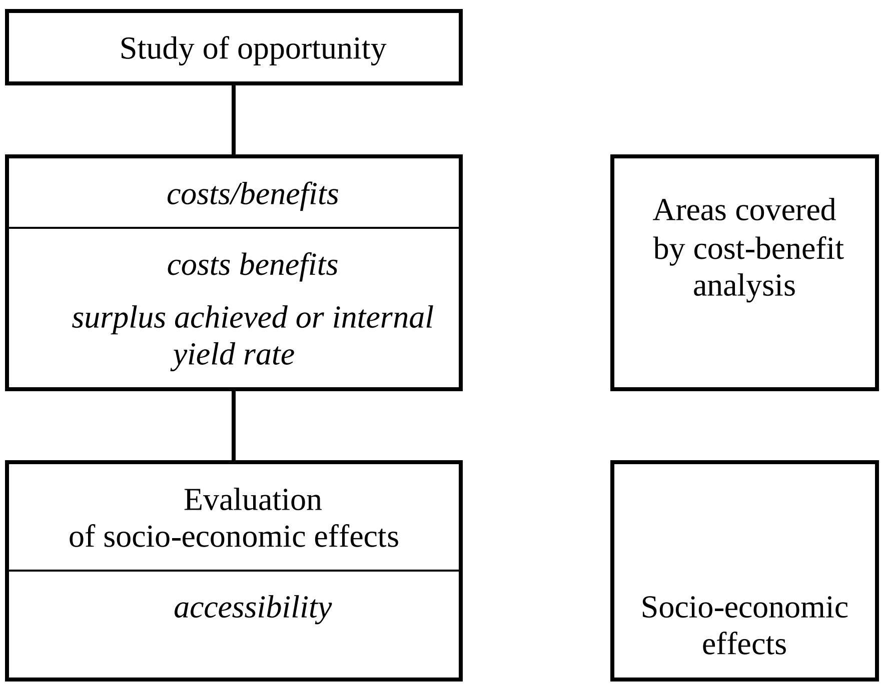
Rietveld then introduces the concept of "reverse effects", which completes this diagram by showing how the actual structure of activities, modified by the infrastructure, in turn affects the need for new infrastructures by exerting fresh pressure on government decisions.

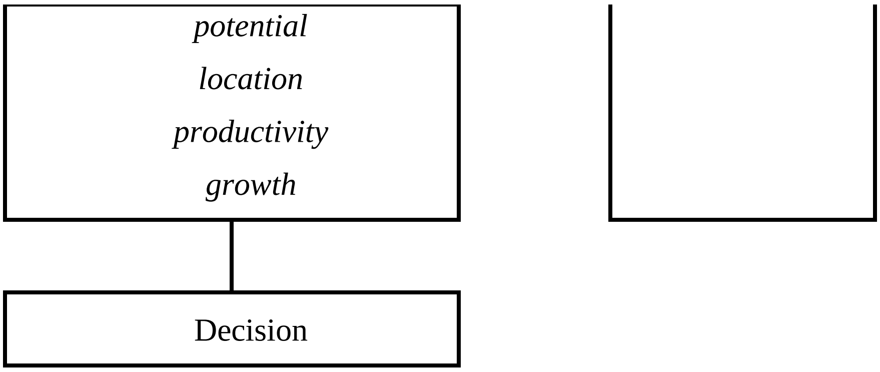
He concludes his analysis by stating that the impact of infrastructure projects on economic and spatial development largely depends on variables specific to the local context, such as demography, the economic structure, technology, etc. The question : "What effect does investment in infrastructures have on economic and spatial development?" therefore seems inappropriate. Rietveld proposes to reword the question as follows :

"What effect does investment in infrastructures have on economic and spatial development, and vice versa, and how is it affected by factors and circumstances from outside the transport infrastructure system itself?"

2.2. Types of effects

While major transport infrastructures are designed with the aim of improving mobility for people and goods, they nevertheless have indirect repercussions which go far beyond the field of transport economics. It is just these indirect repercussions that we refer to when speaking of the infrastructures' *socio-economic effects* (or structural effects). All effects flowing from a new transport infrastructure have a social dimension, so that the term "socio-economic effects" can give rise to confusion. At all events, it needs to be clarified. However, it is difficult to give a precise definition of this term, so that it is preferable, under these circumstances, to start by saying what these socio-economic effects are not.





Within this context, the *socio-economic effects* will be set against the costs and advantages normally considered in a cost-benefit analysis, since this has been the tool traditionally used in evaluating major transport infrastructures. The special feature of cost-benefit analysis is that it sums up the positive and negative consequences of a project in terms of a single value - the surplus achieved or the internal yield rate. However, because of their complexity and diversity socio-economic effects are difficult to measure. Then, for the effects that it is possible to measure, there is the problem of how to aggregate them, since they are not all of the same type. Some represent real advantages (productivity gains, for example), while others are financial advantages (change in property prices through modification of access to a region). There are therefore good reasons for not including socio-economic effects in a cost-benefit analysis. But awareness of them when evaluating the project does give the decision-maker important additional information.

Cost-benefit analysis considers all the benefits (as distinct from the pecuniary benefits), whether they are enjoyed by the users of the new infrastructure ("user benefits") or by other groups ("non-user benefits"). As regards costs, these concern not only the resources used in constructing the project but also the impacts (mostly negative) on man and his environment, that is, the internal and external costs. With the new evaluation methods now available, the field covered by cost-benefit analysis has widened considerably. It is therefore possible to quantify in money terms almost all the non-commercial advantages - especially the environmental impact - and so to integrate them in the cost-benefit analysis.

Cost-Benefit Analysis

Real benefits	Real costs
to the user : • reduced generalised transport cost (reduced cost of use of vehicles ; time saving ; reduced accident risk ; improved comfort, etc.)	Commercial resources : • construction, maintenance and operation of the infrastructure • reduced output of agriculture and forestry
to other groups : • gains in money or time for users of another transport mode	Non-commercial resources : • damage and risks to environment • damage and risks to health

Neither time savings, nor safety improvements, nor reduced risks to man and his environment - all of which come into the field of cost-benefit analysis - are socio-economic (or structural) effects in the sense in which the term is used here. Similarly, productivity gains directly linked to the fall in generalised transport costs - for example, by allowing "Just-in-time" parts delivery - are not structural effects as understood here. However, the question of productivity gains is complex, and deserves to be studied in depth.

The positive or negative consequences of a major transport infrastructure which do not come within the field of cost-benefit analysis can be associated with socio-economic effects. Given the importance of mobility in the smooth running of our societies, any significant modification to transport facilities is likely to influence social structures (family and social ties, cultural integration, standardisation of lifestyles, etc.). Because it is so difficult to identify these social effects (cf. *Coûts et avantages sociaux des transport en Suisse* [Social costs and benefits of transportation in Switzerland], 1988), only the economic dimension of the structural effects will be examined.

Should the effects of building and operating the infrastructure on economic activity be included in the socio-economic effects? We are thinking in particular of the incidence of construction costs. Our feeling is that it is preferable to exclude them from the analysis. First, it should be noted that this expenditure does not give a lasting boost to the regions affected. In addition, we are dealing with a quantity that is not easily interpreted. Finally, we would point out that this expenditure constitutes a pecuniary effect and is not, therefore, taken into account in cost-benefit analyses.

By contrast, an analysis of the effects resulting from a modification to the behaviour and strategies of the parties concerned - firms, household, political authorities - is more interesting. An improvement in the transport infrastructure opens new opportunities to firms (new markets), allows productivity gains to be achieved (benefits of reorganisation) and influences decisions regarding location. The profit a region will derive from a new infrastructure will depend first of all on its potential, but also on the way the authorities are able to integrate the new transport installation into their promotion policy, on the creation of complementary infrastructures, on the quality of regional marketing and on industrial development policy, etc.

Reorganisation : Firms can seek to profit from the new transport infrastructure by improving the production or distribution of their products. For example, "just-in-time" delivery methods require a good transport network. These firms will therefore adapt their production or distribution systems to the new conditions, and thereby seek to make bigger productivity gains than those which result merely from lower transport costs.

Conditions for attracting new firms : if the new infrastructure significantly modifies access to a region, this will affect its ability to attract firms to locate themselves there. An active policy of regional promotion, and identification of relevant firms, can be undertaken under better conditions.

Integration of markets : an improved transport infrastructure gives firms access to a wider market with a resulting increase in competition. Competition improves the performance of firms (additive effect). It can lead to a redistribution of production among regions (distributive effect). An analysis of distributive effects is of special interest when the new infrastructure links regions which are unequally developed or have very different reserves in terms of potential (cf. Guard et al.).

The socio-economic effects have the following main characteristics :

- agents *adapt their strategies* to the new transport conditions ;
- the relation between cause and effect is *indirect* ;
- changes are not immediately perceptible but are spread over *long periods* ;
- they are not of the same kind as transport costs and benefits (*pecuniary effects* rather than *real effects*) ;
- the socio-economic effects are measured with the aid of indicators such as production, employment and the departure or arrival of firms.

3. Methods used for evaluating socio-economic effects

In view of the uncertainty surrounding the "effects" of major transport infrastructures, various methodologies have been used in the different countries faced by this question. The choices made in trying to evaluate these consequences reflect both the methods available and the political decisions governing the development of the infrastructure project.

3.1. Evaluation methods

The first task is to define the scope of the methods to be used for evaluation of a transport infrastructure project. Are the methods to be used for *ex-ante* or *ex-post* evaluation? The former refers to expected or anticipated effects, the latter to changes arising from completion of the project. It is necessary to draw up a list of expected socio-economic effects which are associated directly or indirectly with the project, on a temporary or permanent basis, and this implies knowing exactly the scope, objectives and time scale of the project. There has to be some understanding of the relationships between the infrastructure project and the theory applied to analysis of it. This may include export base theory, growth-pole theory, gravity models and location theory.

Finally, it is desirable to be able to measure and quantify the effects in an evaluation study. This calls for the formulation of a methodological framework and the definition of evaluation methods (methods to aid decision-making). A simple method is to indicate the direction of change and if possible its intensity by using a "plus" and "minus" system. A more sophisticated approach is to quantify the individual effects and bring them together within a common framework. To obtain a single representation of multiple effects, it is possible to draw up transformation matrices to indicate the technical trade-offs between different components and the relative priorities and degree of preference between the different aims and objectives. Cost-benefit analysis, multi-criteria analysis and a points-rating system are often used as accounting methods. Variants of these techniques are Hill's "Goals achievement matrix" and Lichfield's "Planning balance sheet".

Methods used to determine socio-economic changes related to infrastructure projects include the following :

3.1.1. Modelling

Traditional transport models analyse traffic flows and volumes and can observe changes in their composition, distribution, choice of mode and mobility induced by the infrastructure. Changes in travel costs and journey time affect personal mobility and improve reliability of delivery of goods. This can lead to changes in economic activities, production processes and the location of industries, offices and homes. In time this can affect spatial and urban structures. To measure long-term effects, it is necessary to go beyond static transport models and use dynamic ones. The latter are still in their infancy, and even though theoretical models have been developed in many countries, their practical application remains limited and their accuracy is subject to fierce dispute amongst analysts, planners and modellers.

3.1.2. Descriptive and prospective studies

These qualitative studies based on interviews with experts are often undertaken to study the factors behind choices of location, to prepare mental maps of what firms or individuals intend to do, and to examine the decision-making processes in response to transport improvements. Questionnaires are also used in these studies.

The "revealed preference" approach shows what individuals or firms actually do. The "stated preference" approach based on simulation games is used to determine what firms or individuals will do in hypothetical situations. These are tools for understanding the processes by which complex decisions are made.

3.1.3. Case studies

These use statistics and analysis to determine changes in rates of economic activity such as employment levels, floor space used in various sectors, income and expenditure of residents, profitability of companies, property rents and land values in adjacent areas where accessibility has improved. The difficulty is to measure the effects that can be attributed to the transport infrastructure project when the local economy is being affected by other changes in the same period.

3.1.4. Statistical analysis

This includes econometric analysis and is often done to identify and estimate any significant changes in the production function or cost function as a result of investing in major infrastructure projects. Researchers use input/output tables and time series data from national or regional statistics.

3.1.5. Graphic representation

This allows observation of changes in spatial structure and urban form. The relationship between the large-scale transport project and socio-economic changes is represented but not explained. However, this technique gives information on changes in a visual form which is easy to absorb.

3.2. Methodologies

In the relevant literature, therefore, we find a great variety of methods of evaluating the relationship between the transport infrastructure and regional development.[5] The choice of method will depend on the aim in view (*ex ante* or *ex post* analysis), on the scale of the project (regional, inter-regional or international link) and on its type (road or rail link, priority for passenger or goods transport, etc.). A simple analysis has the disadvantages of yielding little information and of leaving a wide margin of subjective assessment for the analyst or decision-maker, whereas a complex model often comes up against a lack of, or the poor quality of, non-aggregated, region-specific data, as well as the fact that the actors' behaviour does not have the rationality attributed to it by the model.[6]

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5 For a good presentation of the different types of models, see Rietveld 1989.

6 For more detail on this, see the paper compiled by R. Maggi on gravitational models in the annexed report.

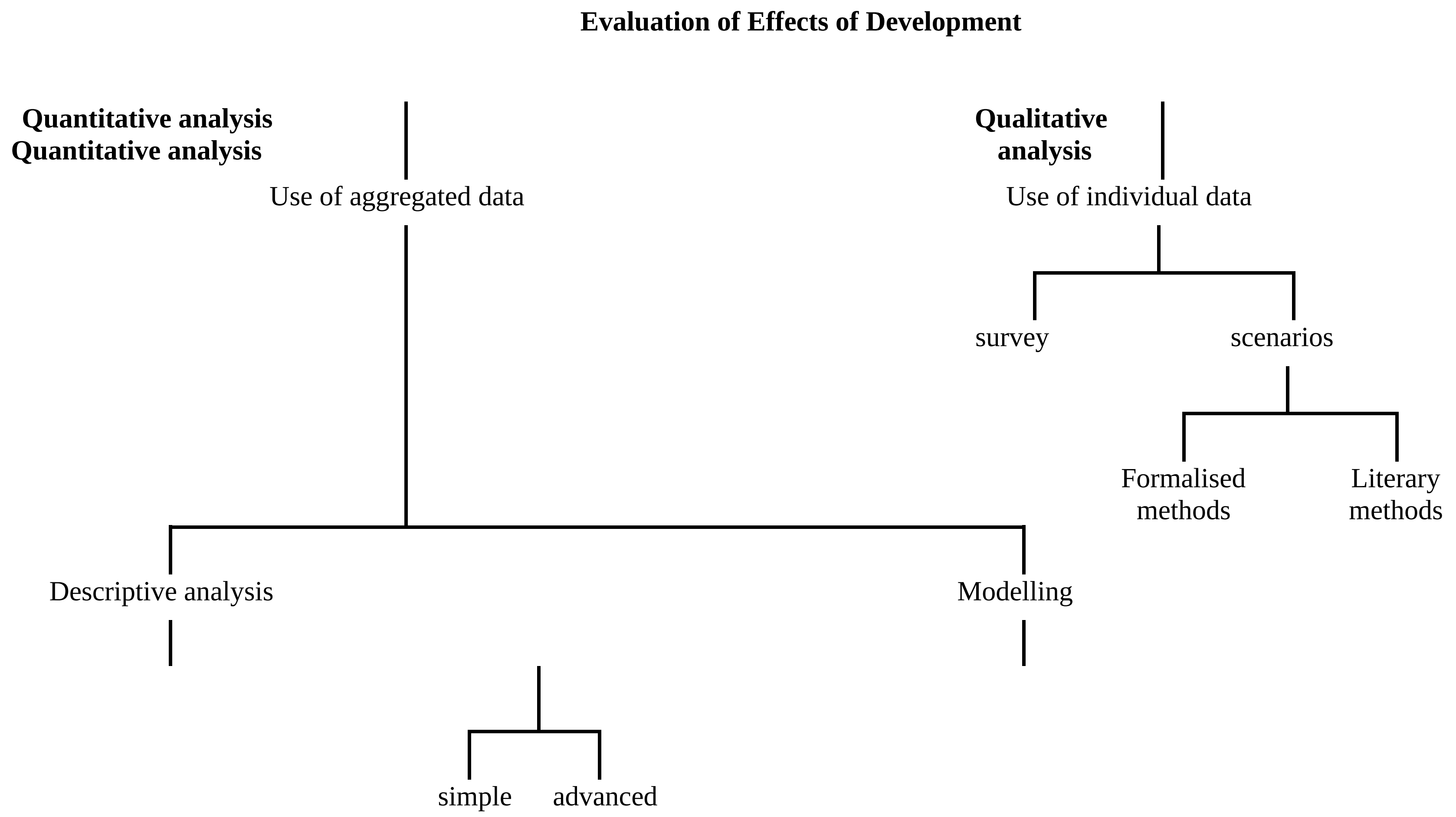
Quantitative analyses are generally based on aggregated data. Some methods are purely descriptive in the sense that the are not based on a model of how the economy operates and of how economic activity relates to transport. Isochrones, iso-cost graphs, as well as some gravitational models or models of simple potential, are of this type. In more advanced analyses, potential is integrated into an econometric or statistical model (Dogson 1974 ; Kesselring, Halbherr and Maggi 1982 ; Maggi, Halbherr and Kieliger 1985). In these models the transport infrastructure is viewed as a factor affecting the location of firms, and the emphasis is put on improving accessibility. Linear programming models offer an alternative to measuring gravitational potential. Development effects can be estimated using both types of approach.

Inter-regional simulation models allow the inter-relationships between transport infrastructure and regional development to be studied. The transport infrastructure is then envisaged as a determinant of inter-regional exchanges (Meplan Model in *The Regional Impact of the Channel Tunnel* 1991 ; Amano and Fujita 1970). One of the practical problems encountered in applying this kind of model is the difficulty, or even impossibility, of obtaining technical coefficients for the table of inter-industry exchanges by region. The use of national coefficients implies the assumptions that the proportions between factors are identical in all regions, and that there are no economies of scale (Straszheim 1972). The transport infrastructure is also a production factor, capable of increasing the productivity of other factors used by firms. Likewise, an inadequate infrastructure can lead to reduced productivity of other factors. But this type of approach presents a major drawback when one has to estimate the effects of growth : we have no very clear idea of what is to be measured - short-term or long-term effects, pecuniary or real effects.

Qualitative analyses allow a deeper study of behaviour and attitudes, and of the way in which an improvement in the transport infrastructure is perceived by decision-makers or experts.

Isochrones allow a comparison of accessibility starting from a given centre before and after the creation of a new road or rail link, and description of the accessibility provided by different variants of a project on the same page (cf., for example, Gaudard et al. 1985). Cartographic and isochronous forms of presentation exist ; the localities which may be influenced within a chosen time-span are linked up (cf. Maillat et al. 1982). Along the same general lines, one can describe the changes occurring in accessibility by means of iso-cost graphs (locus of points for which the generalised cost of travel from a given centre is identical). Disadvantages : isochrones and iso-cost graphs tell us about the variation in absolute accessibility, whereas relative accessibility is undoubtedly more important when evaluating attractiveness and regional growth. A further disadvantage : these methods do not take account of relative mass and give no indication of possible negative effects.

Typology of methods



In order to obtain an indicator of accessibility which takes account of population mass, the proportion of the population of a reference group that may be affected within a given time interval is measured. It is considered that a period of 30 minutes allows intra-regional accessibility to be measured, while a period of 2 hours is needed to measure inter-regional accessibility. The reference group in the first case is the region and in the second the country.

To render the indicator dynamic and to show the consequences of an improvement in the transport infrastructure, the time interval is increased - for example, from 30 to 45 minutes for intra-regional accessibility and from 2 to 3 hours for inter-regional accessibility (*Etat-major pour les questions de transport* [General survey of transport questions] 1988).

When the aim is to predict a possible growth effect, it is open to question whether the population is a good indicator. It would doubtless be preferable to use revenue or production. In addition, it would be appropriate to take account of the way the network is used, and therefore to analyse production by type of activity. The applications of the gravity model in spatial economics are numerous. This is certainly the model most often used in studying the relationship between transport infrastructure and regional development.

It is most usually formulated as follows :

$$\mathbf{I_{ij} = kM_i^{\propto}M_j^{\beta}f(d_{ij})} \qquad \mathbf{(1)}$$

Where

ij	: starting points and destinations
I	: interaction
k	: constant
M	: mass
$\propto,\beta$	: parameters to be estimated
d	: distance

The choice of mass and of indicator of resistance determines the results yielded by the model. If we are interested in exchanges of goods, an indicator of economic activity needs to be introduced into the model to measure mass. In practice, population or employment (sometimes subdivided into economic sectors or industries) are used. As regards distance, it is measured in km, in journey time or in travel cost (generalised transport cost). Finally, we have to decide how to specify the spatial resistance function - in other words, how to introduce into the model the effect of distance on interaction (quadratic or exponential function). The gravity model allows us to analyse the effects of economic development on transport, as the dependent variable is interaction (or the intensity of exchanges between regions). If we are studying the inverse effect, that is, the effect of transport on regional development, it is better to use the model known in the literature as the model of gravitational potential or of economic potential.

The potential V_i is obtained as follows :

$$\mathbf{V_i = I_{ij} / M_{ii} = \sum\Sigma\, M_j\, f(d_{ij})} \qquad \mathbf{(2)}$$

Potential is an indicator of the attraction of point i as a function of the attraction of masses in space. Attraction corresponds to the sum of the masses weighted by their accessibility. Some authors speak of an accessibility indicator. They then multiply the sum in (2) by M_i (Rietveld 1989).

Gravitational interaction and potential

The economic development (or decline) of a region is reflected by an increase (or reduction) in the demand for transport and by an intensification (or slackening) of spatial interactions. Conversely, a change in the transport system (improvement of infrastructure, adjustment of tariffs, etc.) is reflected in a variation in the region's potential and in its growth prospects.

Simple (or descriptive) uses of the gravity model can be distinguished from advanced analyses (cf. fig. below). In the simple models, potentials are often presented in cartographic form (Clark 1969). Advanced analyses integrate potentials into a statistical or econometric model (Dogson 1974 ; NEAT 1988 ; Maggi et al. 1985).

Typology of Gravity Models and gravitational models

Gravity models have a certain interest when analysing the relationship between development of transport infrastructure and regional growth. However, their use does pose a certain number of problems.

When this type of model is used, it is admitted that growth in production or employment in a region depends on the relative distance of its firms (i.e. as compared to other regions) both from current or potential markets and from sources of supply and inputs.

It is also admitted that the gravity model gives a good explanation of the flow of goods between regions. However, empirical analyses carried out in order to verify this last hypothesis have yielded contradictory results.

The gravity model allows us to identify not only a development effect but a draining effect. A reduction in transport costs leads to intensified competition between regions, and entails an increase in inter-regional trade and a growth of firms in regions with low production costs at the expense of firms in less efficient regions. Behind this mechanism, however, is an assumption which is never made explicit : it is supposed that the rhythm of a region's economic development is a function of the growth of the firms in the region (endogenous development), but the possibility of a mobility of firms between regions (exogenous development) is not envisaged. This is a serious limitation to the validity of the model.

A statistical model allows us to test the existence of a relationship between a variation in production and changes in the transport infrastructure. Here, we can use a model of multiple regression, a variance analysis or an analysis of the correlation of ranks (Kuehn and West

1971). One of the difficulties is how to measure the "transport" service. In the absence of data on mean distances covered by goods (or transport times), an indicator sometimes used is the length of the network weighted by a quality index. The second problem lies in the meaning of causality. Most often, it is implicitly admitted that it is adjustments to the transport infrastructure which determine economic development, and not vice-versa. However, there is a procedure which enables us to detect the direction of the causal link using an analysis of time-lags as the starting point.

Quantitative models are often characterised by a very mechanistic approach to the relationship between transport and economic development. This is especially true for gravity models. Plassard (1989) recommends abandoning any mechanistic viewpoint when studying the effects that can be generated by a major investment in the field of transport. "These effects are mediated by various factors that need to be identified more clearly : economic and political decision-makers, institutional actors, etc.". The infrastructure should be understood as one element among others in the ensemble of changes undergone by regions, and not as a cause with affects that we are trying to predict.

In order to understand the effect a major alteration to the transport infrastructure can have on the strategies of firms, it is preferable to use a qualitative approach (survey, interviews). If the aim is to predict the long-term effects of investment in the transport infrastructure, one must also be clear about the intentions and strategies of the regional political authorities concerned ; one must be aware of the back-up measures they intend to take and the effort they are ready to make to take advantage of this new opportunity (cf. *The Regional Impact of the Channel Tunnel* 1991). It can also be useful to consult experts (in the different areas affected by the project). For this, the interview technique or more complex methods (Delphi, for example) are used.

A qualitative analysis is also the only means of identifying or predicting the psychological effects of a major investment in the transport infrastructure (changes of attitudes and habits, effects of demonstrations, brand image phenomena).

The *scenarios method* is of special interest when evaluating the long-term effects of a transport infrastructure. While traditional prediction methods are based on the use of quantitative and determinist models and are supposed to yield a single result, the prospective method uses qualitative or stochastic methods and enables us to envisage several possible futures. Among the realisable ones, it is a matter of choosing those which best meet the needs of the population concerned. The scenarios method is the tool used to apply the prospective approach. A scenario is a description of a future state and of the path(s) leading to it (Godet 1973). In order to construct scenarios, one can use formalised methods (Delphi, crossed-impact matrices) or a less formal procedure, based on reflection and reasoning, which comprises a series of logical stages (the "literary method").

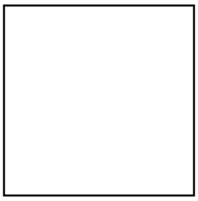
One of the advantages of the scenarios method is that it compels the analyst to situate the new transport link within a wider system, to analyse the inter-relationships between the different variables of the system (the new transport link is only one of the determinants of the possible development of the regions studied, among many others). It should be noted that this method lends itself especially well to taking account of accompanying policies (the region exercises control over its future and its policies can therefore modify the effects of a new infrastructure).

As regards the evaluation of the economic situation and the production conditions of firms located in the regions most directly affected by the project, it is necessary to bring together economic and demographic data (the labour market in particular), as well as information on the quality of the infrastructure and of the natural environment. The transport infrastructure is never a sufficient condition for the development of a region, but is one element among others in decisions on the location of investments. An investment in the transport field has more chance of having a positive effect in a region where the other conditions for location are favourable.

3.3. The importance of back-up policies

More and more doubts are being expressed about the existence of a causal link between investment in transport and regional development. The effects are not automatic and, before assessing the impact of a new transport link on regional development, it is worthwhile to evaluate carefully the socio-economic environment of the region and the general conditions affecting location of firms. It is also important to be aware of any *improvements of amenities* already undertaken or planned by the local authorities, and the way in which improved accessibility will influence the strategies of firms (Plassard 1990).

Back-up Policies



Regarding the analysis of the socio-economic environment and of local potentialities, it will be noted that the fact that a region has a good transport infrastructure is a necessary but not a sufficient condition for ensuring its development. If the general conditions for the location of transport-sensitive activities are good, the probability that investment in the transport infrastructure will promote development of the region will be increased.

To begin with, a first analysis of the general situation of the region is made (population, employment market, economic fabric, services to firms, quality of the social infrastructure, indicators on economic performance and competitiveness, etc.), including an analysis of the current situation as regards transport. It is important to know whether investment in the transport infrastructure is intended to remove a bottleneck (passive strategy) or whether its aim is to increase transport capacity in order to augment future demand (active strategy). It will also be asked whether the investment is perceived as bringing about a qualitative change to the transport services provided (for example, linkage to the motorway network).

We also need to know how the socio-economic environment is perceived by the firms already in place and by potential investors, and in what way the new transport link fits into the firms' strategies (qualitative analysis).

The importance of back-up policies in taking advantage of investments in the transport infrastructure and increasing the positive repercussions on the regions served is recognised (Gac 1991 ; Hidber et al. 1975). These are some of the main elements of a policy designed to derive maximum advantage from the transport infrastructure.

Axes of a regional enhancement policy

We have noted that interdependencies exist between the various components of the *infrastructure*. This being so, should we favour a balanced growth of all elements in the system or, on the contrary, concentrate our efforts on certain items of equipment meeting specific needs ("creating bundles of collective equipment", Frey 1979)? Since we are aware that the infrastructure is only one of the factors influencing the location of firms (and probably a secondary factor, Schröder 1968), and bearing in mind the financial constraints, the second option is undoubtedly the only possible one in outlying regions. Installations which constitute a factor of production for firms (telecommunications, training, research centres, etc.) deserve special attention. However, infrastructure installed primarily for households should not be neglected. As is shown by Frey (1979), as the standard of living rises the importance of the infrastructure intended for households increases while that of the infrastructure for firms diminishes. The psychological effects that can be caused by an improvement to the infrastructure will also be considered (cf. Gaudard 1975).

(Private) services to firms certainly also play an important role as factors affecting the location of productive activities. This observation is confirmed by the number of existing firms which choose to entrust to third parties all functions that can be fulfilled more efficiently from outside. It is then essential to be able to find in place firms able to provide the services sought.

The *quality of the environment* (natural and man-made) is an important factor in a region's attraction, not only for households but also for productive activities. However, this is a given factor and possibilities for influencing it are slight or even non-existent.

The most important variable in back-up policies is the policy regarding *economic promotion* and *regional marketing*. It is probable that the new transport infrastructure will have a positive influence on employment and that growth will be significantly greater if the region adopts an active policy of economic promotion and of seeking to attract companies (exogenous development). We are witnessing an increasing decentralisation of regional policy, which is taking the form of competition between regions to attract economic activities and employment to their territory. This tendency, which is taking place in the context of a general movement seeking a decentralised solution close to the market for economic problems, may be desirable in terms of efficiency ; nevertheless, the dice should not be loaded. A good transport infrastructure which allows rapid links between the main centres is a necessary condition for competitiveness between different regions.

3.4. The needs of data

An important activity within the COST-317 action programme is to define the evaluation framework and to advise on the development of methodologies to measure the socio-economic effects associated with major transport infrastructures. An important question that has been identified concerns the temporal and geographical aspects in data collection and in impact analysis.

3.4.1. Description of issue in question

Temporal aspect refers to the collection of historical data (a documentation of what has happened in the past) and the assembly of information concerning the prediction of developments in the future (what will happen in future years with or without the implementation of proposed infrastructures). Availability of historical data is important because they are the building blocks for rational decision making. Data analysis ipso facto describes the evolution of regions and cities (descriptive analysis), and provides a useful tool to study the factors and their inter-relations which have played a role in determining (or influencing) the course of events in the historical past (explanatory analysis). At the same time, historical data offer the necessary raw materials to gain insights into plausible developments in the future (forecasting) as a direct result of implementing (or not implementing) specific transport improvements. Moreover, temporal data are needed to determine the relative merit (in qualitative analysis) or value (in quantitative analysis) of different project proposals (evaluation studies) as means to achieve policy goals and objectives.

Trend extrapolations, scenarios studies, experts' informed judgement, forecasting models and evaluation techniques are methods to assist project managers to assess the differential contributions of alternative project proposals. Historical data such as time series statistics, repeated cross sectional studies and longitudinal panel data are the raw materials. Specialists' techniques such as causal analysis, simulation games etc. are the tools to help decision makers to design, to develop or/and to evaluate policy measures in the strategic planning process.

Geographical aspect refers to the collection of data in the spatial dimension, that is the assembly of disaggregated data per geographical region, per country or per zone within a country. The appropriate level of disaggregation depends on the purpose of the study and the level of details that is demanded. Very often, the required geographical range is combined with a request to collect such data also in a temporal context. In another words, the task is to collect disaggregated data by geographical stratification over a given time period. The terms of reference should specify clearly the requirements. Generally speaking, the finer the level of disaggregation, the higher is the cost of collection but (in return) the higher is the level of accuracy at an aggregated level.

For impact analysis, it is important conceptually to distinguish the temporal aspects of diverse effects that could be attributed to the infrastructure investment. Effects can be designated over three time horizons : short term (up to 1 year), medium term (1 to 5 years) and long term (over 5 years). Such concepts are relative and can be redefined in other ways, depending on the nature of the study and the type of project. The time dimension refers to the length of the period before direct and indirect effects work their ways through the economy such that they can be observed and measured. This is particularly a case in point with regards to the restructuring of the socio-economic fabrics of the regional economy, a phenomenon that takes time to manifest.

Likewise, an impact analysis should take into consideration the geographical spreading of different effects. Do the effects concentrate within a given area (localised impact)? Or do they spread over a wider area (diffused pattern), possibly across national frontiers. Furthermore, it is important to distinguish two aspects : generative effects (which give rise to a net increase in the gross national product) and redistributive effects (which only lead to a redistribution of benefits or gains from one sub-region at the expense of another sub-region). The former comes as a result of increases in overall capital or labour productivity and the economy as a whole has become better off. In the latter, the economy in balance has not changed and the balance of advantage has only shifted from one area to another within the total economy. This distinction is important because the results of impact analyses often determine the relative worthiness of project proposals.

A major question for discussion concerns the policy goals and objectives for which the project proposals are designed to achieve. If the goal is to achieve economic growth, the emphasis is on the pursuit for an increase in economic welfare for the nation. However, if the goal is to achieve better redistribution of resources between regions, redistributive element has to be taken into account in the decision making process.

3.4.2. Additional considerations for international studies

Considerations described above apply generally to national studies with a common source of data and standardised statistics. For comparative studies and international research e.g. the analysis of cross frontier effects, there are additional considerations :

3.4.2.1 Availability of data

In some countries, certain types of data are not collected or are kept confidential (i.e. not readily available). Collection and production may take considerable time before they are published. A particularly important point within the European Union is the abolition of the practice to collect freight statistics at the border for flows of freight traffic which are generated and destined for a member country within the EU, following the completion of the Single European Market on 1 January 1993. It also raises an important question regarding continuity (i.e. the future availability of data) when existing primary source may become no longer available or the method of collection is changed radically resulting in structural breaks in the data series.

3.4.2.2 Compatibility of data

This is an important issue because systematic analysis for comparative study requires that the data source should be identified, collated and rendered compatible to ensure consistency and accuracy. Different national and international data sources have to be scrutinised in terms of method of collection, definitions used, agreed level of statistical precision, setting of quality standards regarding freshness of data, extent and scope of coverage as well as level of disaggregation. Very often, available data have to be transformed and converted into a common base using a mutually agreed evaluation framework before analytical study can start.

4. Conclusion

The preceding analyses show clearly the strong links between methodologies, the necessary data and the objectives assigned to major transport infrastructures, which appear as soon as we begin to evaluate their consequences for the socio-economic environment. The effects cannot be defined in absolute terms, and no method emerges as the best suited to answering this question.

It is therefore necessary to pose the question of the socio-economic effects of major transport infrastructures in a more empirical way, to understand how and why one methodology has been adopted rather than another in the diverse situations which have been studied in different countries. A study of current practices clearly shows the diversity of possible approaches to the effects of major infrastructures ; it also allows us to find out how to extract from this diversity some lessons which will allow us, if not to unify the various evaluation processes, at least to make them susceptible to comparison.

PART TWO : THE USUAL METHODS OF EVALUATION OF MAJOR INFRASTRUCTURES

1. Examples of major infrastructure projects in the European Union

by Dr. Odile HEDDEBAUT

1.1. Introduction

The Green Paper[7] inspired by Jaques Delors President of the Commission, considers that transport infrastructure projects can play a key role in boosting the economy, both directly, through the stimulation of demand which can be expected from major project decisions, and in the longer term, through the increase in the level of economic competitiveness which can be expected from practical and organizational improvements in the mobility of people and goods (socio-economic effects, network effects, etc.).

Initially, a list of 26 transport infrastructure projects was identified, which was then expanded to 34 projects, of which 11 were designated as priority projects (to be carried out by 2010) at the Corfu Summit in June 1994.

The Group presided over by Mr Henning Christophersen, Member of the Commission, reported its conclusions at the Essen Summit in December 1994. The list of major transport projects was rearranged according to progress with the financial arrangements. Another three projects were added to the list of 11 projects of June 1994, including the Ireland/United Kingdom/Benelux road link which had previously put at sixteenth place in the Corfu list, the high speed Milan-Rome-Naples rail link designed to complete the Brenner axis,which was previously classified as number 31, and the Nordic triangle, subject to their accession to the Union.

[7] European Commission: "*Growth, competitiveness, employment - The challenges and ways forward into the 21st century"* - White Paper, EC, Brussels-Luxembourg, December 1993, 176p.

List of the 11 priority projects approved by the European Council in Corfu, June 1994

Projects	Countries concered
1. Brenner axis : High Speed Train (HST)/combined rail transport link between Berlin and Verona	Italy, Austria, Germany
2. HST North : (Paris), Brussels, Cologne, Amsterdam, London	Belgium, Germany, Netherlands, UK
3. HST South : Madrid-Barcelona, Perpignan-Madrid, Vitoria-Dax	Spain, France
4. HST East : Paris-Metz-Strasbourg, Metz-Mannheim, Metz-Luxembourg	France, Germany, Luxembourg
5. Betuwe line : Combined /conventional rail transport Rotterdam-Rhine-Ruhr	Netherlands, Germany
6. HST South-East : Lyon-Turin	France, Italy
7. Greek motorway : Patras-Greek/Bulgarian border	Greece
8. Iberian peninsula motorway : Lisbon-Valladolid	Portugal, Spain
9. Irish rail link : Cork-Dublin-Belfast-Larne-Stranraer	Ireland, UK
10. Italian airport : Malpensa (Milan)	Italy
11. Scandinavian link : fixed rail/road link between Denmark and Sweden	Denmark, Sweden

Thus the new classification of priority projects is as follows :

Work begun or to begin before the end of 1996 (list of the 14 priority projects subdivided into five categories) *1. Projects with financing guaranteed by a public/private sector partnership.* *2. Projects which are publicly funded on the basis of user charges with State guarantees.* *3. Conventionally funded rail projects.* *4. Projects benefiting from large EU subsidies for reasons of cohesion.* *5. Projects with an open financial package.*
Other major projects (list of the other major infrastructure projects subdivided into two categories) *1. Projects which can be speeded up so that work can begin within two years or so.* *2. Projects which need to be examined more closely.*

The criterion whereby projects are designated as priority projects seems to be the method of financing the project and whether or not financial arrangements are more or less complete.

List of the 11 priority projects approved by the European Council in Essen, December 1994

Work begun or to begin before the end of 1996
1. Projects with financing guaranteed by a public/private sector partnership. . High speed train (Paris)-Brussels-Cologne-Amsterdam-London. . Betuwe line. Combined transport/conventional rail. . Malpensa airport (Milan). . Ireland/United Kingdom/Benelux road link.
2. Projects which are publicly funded on the basis of user charges with State guarantees. . Scandinavian link : fixed rail/road link between Denmark and Sweden. (Øresund)
3. Conventionally funded rail projects . High speed train/combined transport North-South : Nuremberg-Erfurt-Halle/Leipzig-Berlin, Brenner Axis-Verona-Munich. . High speed train South : Madrid-Barcelona-Perpignan-Montpellier, Madrid-Vitoria-Dax. . High speed train East : Paris-Metz-Strasburg-Appenweier (Karlsruhe), Metz-Mannheim, Metz-Luxembourg. . Brenner axis high speed train : Milan-Rome-Naples.
4. Projects benefiting from large EU subsidies for reasons of cohesion. . Greek motorways : Pathe and Via Egnatia. . Motorway Lisbon-Valladollid. . Conventional rail link Cork-Dublin-Belfast-Larne-Stranraer.
5. Projects with an open financial package. . High speed train/combined transport France-Italy : Lyon-Turin ; Turin-Milan-Venice- Trieste. . Nordic triangle (subject to accession). Main west coast rail link.

This serves to emphasize even more the acute problem of methods of evaluating the repercussions of these large-scale projects and the possibilities for making comparisons between these various projects in order to determine an order of priority for implementation, and the possibility of including European funds in their financial packages.

Nevertheless, these major infrastructure projects complete sections missing from networks or missing links between national and/or physical borders, a topic which is covered in the next section.

1.2. The missing links

Projects to supply the missing links needed to ensure the mobility of people and goods under the 1994 objectives have been the subject of considerable discussion, especially over the last ten years.

In its 1984 paper[8] the Round Table of European Industrialists depicts the various bottleneck corridors in the road and rail networks. (see Maps 2 and 3).

Some years later, the same group took its analysis and proposals for transport infrastructure even further by incorporating them into organized networks.[9] This network concept of transport links is of universal importance when devising infrastructure systems, particularly in Europe. It is incorporated as such into the Treaty of Maastricht, as we have already seen, which is a sign of the changing concept of how transport systems should be organized and reflects the increasing move towards geographical integration. There is no denying the fact that geographical factors alone have underlined the need to fill in the missing links in order to improve the actual physical linkage between economies following the various enlargements of the Community (United Kingdom, Greece, Spain and Portugal) (See Map 1).

Thus some of the new major infrastructure projects are designed to complete missing links or to improve capacity on enforced links where there are road and rail bottlenecks. Others reflect the need for continuity of road or rail networks and thus come into the category of missing networks, thus ensuring continuity between the various areas of Europe and facilitating their further integration.

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8 "The Missing Links", Round Table of European Industrialists, December 1984

9 *"Missing Networks in Europe"*,Round Table of European Industrialists. Study prepared by a team (NECTAR) of the European Science Foundation, 1990, 84p.

Map 1 - Missing links in Europe [10]

[10] Courrier international- Der Spiegel, " L'Europe à grande vitesse, Numéro spécial : Alerte à l'écologie ", pp. 45-53

Map 2 - Road missing links in Europe[11]

11 Table ronde des Industriels Européens, " Les maillons manquants ", décembre 1984 numérotation multiple + Annexes

Map 3 - Rail missing links in Europe [12]

[12] Table ronde des Industriels Européens, " Les maillons manquants ", décembre 1984 numérotation multiple + Annexes

1.3. The perspectives of achievement

1.3.1. Road network

1.3.1.1. Pyrenees crossing

New rail links crossing the Western and Eastern Pyrenees create the possibility of a high-speed link between Madrid and Bordeaux/Narbonne. A motorway is due to go through the centre of the Pyrenees

1.3.1.2. New Alpine tunnels

Projects are afoot for rail tunnels beneath the Simplon, Gottland and Brenner passes. They should ease traffic over the passes and promote the freight trade between Italy and Central Europe.

1.3.1.3. Road links resulting from German unification in 1989

Modernization of the road network in the former GDR ;

1.3.1.4. Road links at the edge of the Community

New connections with countries adjoining the Community, such as Scandinavia and Central Europe. (See the map of links across the Baltic)

Map 4 - The links through the Baltic Sea[13]

Map 5 - The three alternative routes

[13] Civil Engineering and Construction Gazette, "Fehmarn Belt: bridge or tunnel?", 15 January 1993, p.28.

1.3.2. The high-speed train network

Two major axes are considered to have priority status and justify funding from the European Community :

1.3.2.1. In the North

- Paris-London-Brussels-Amsterdam-Cologne, plus links with other Member States ;
- 1993 : new line Paris-Lille-Frethun (Channel Tunnel) ; Paris-London and Paris-Brussels links with high-speed trains (TGVs) running on conventional tracks ;
- 1995 : new line Lille-Brussels ; track upgrading Aachen-Cologne and Rotterdam-Amsterdam ; Paris-Brussels-Amsterdam and Paris-Brussels-Cologne links with high-speed trains (TGVs) running on conventional tracks[14] ;
- 1998 : new line and upgrading between Brussels and Aachen ;
- 1998 : new line and upgrading between Brussels and Rotterdam : this high-speed passenger train (TGV) link has been approved by the government but 50% of the cost must be covered by the private sector ;
- 1998 : new Cologne-Frankfurt line ; high-speed train (TGV) link Paris-Brussels-Cologne-Frankfurt ;
- by 1998 : new line Hannover-Berlin ;
- by 2000 : new line Channel Tunnel-London.

1.3.2.2. In the South

- Seville-Madrid-Barcelona-Lyon-Turin- Milan-Venice, then to Tarvisio and Trieste ; Oporto-Lisbon-Madrid ;
- 1992 : new line Seville-Madrid ;
- under evaluation : new line Madrid-Barcelona ;
- under evaluation : new line Barcelona-French frontier-Perpignan[15] ;
- by 2000 : new line Milan-Rome-Naples ;

infrastructures providing access.

All the missing rail links, referred to as "key links", are shown in the two maps below :

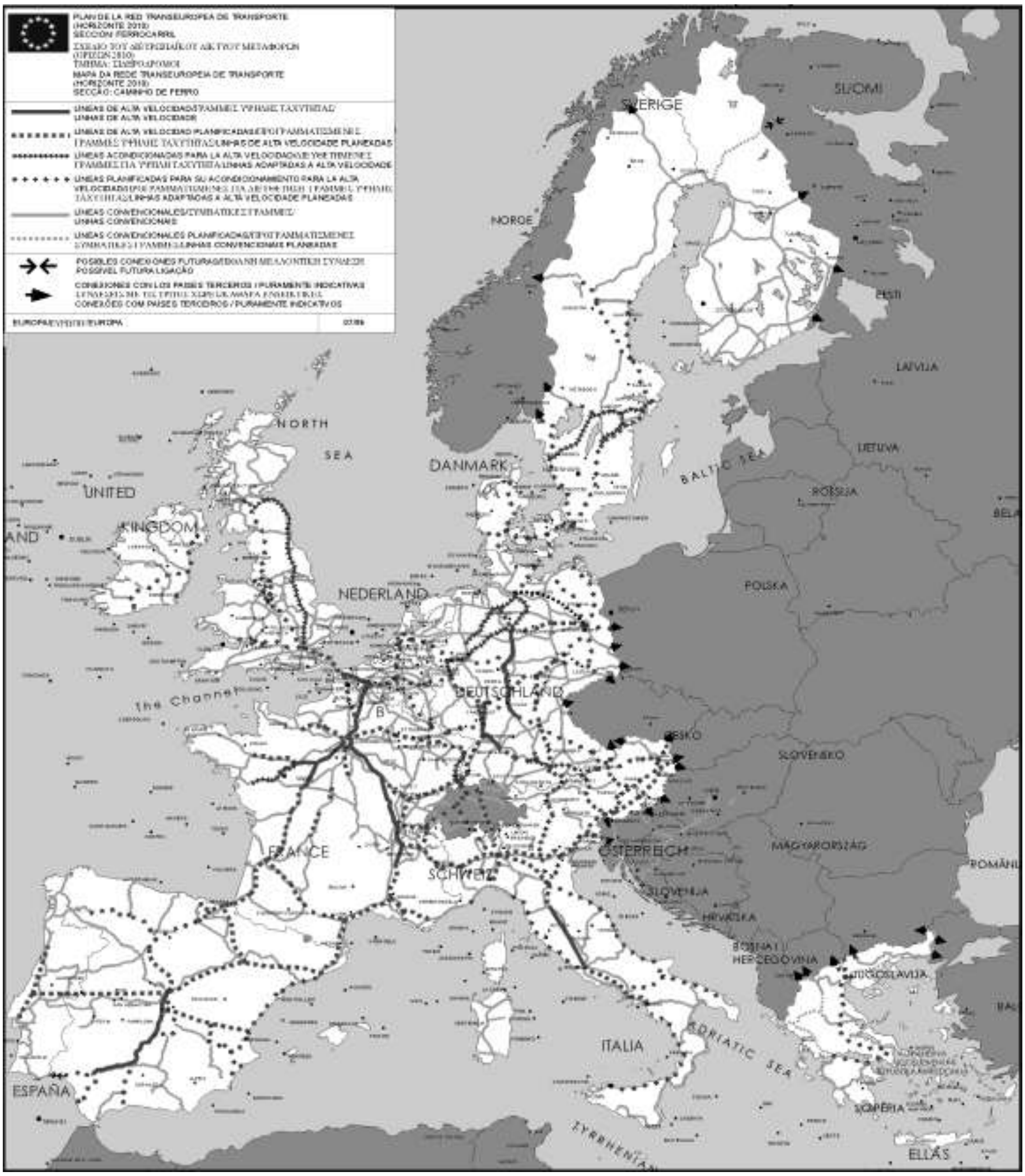
[14] Michel Walrave, "Les réseaux et l'ouverture des frontières", Annales des Mines, Réalités Industrielles: L'Europe des grands réseaux," April 1991, pp. 19-25.

[15] Andrés Lopez Pita & Alain Richard, "Un maillon clé pour les relations ferroviaires internationales, la ligne nouvelle Barcelone -frontière française", Revue Générale des Chemins de Fer, October 1992, pp. 37-43.

Map 6 - Outline plan of European high-speed train network[16]

[16] Commission of the European Communities Européennes, " Les perspectives du territoire communautaire ", Les actions communautaires : les liaisons manquantes dans les réseaux de transport de la Communauté, Europe 2000, 1991,p.79

Map 7 - Major construction sites of the future[17]



17 Le Moniteur des Travaux Publics et du Bâtiment, " Europe le jour "J", 1er janvier 1993, pp.10-11.

1.3.3. Combined transport network

The Community is drawing up an outline plan of combined methods of transport in order to construct a network of railway lines and terminals and to study the integration of road, rail, river and maritime transport systems, which is the basis of a multimodal approach.

"Combined transport is a specific form of organization. It is neither road nor rail, nor the mere juxtaposition of the two modes, but an original technique which revolves around the SNCF and two main operators in France : NOVATRANS and CNC, which dominate the market. NOVATRANS concentrates on articulated trucks and CNC on container traffic. The transport of swap bodies is divided between the two operators."[18][1]

A number of projects are already receiving Community funding. These include :

- the Brenner axis across Austria and Northern Italy ;
- the United Kingdom-Benelux-Italy axis ;
- the Germany-Spain-Portugal axis (track widening).

Other projects are in existence, such as the rail link for rapid goods transportation between Rotterdam and Germany.

In addition, the "Alptransit" rail project promotes the use of combined methods of transport in aiming for a deliberate balance between road and rail. This project should also be of service to various regions of Switzerland. It consist of two new tunnels beneath the Saint Gotthard and Lötschberg passes (49 km and 28 km respectively). The project also envisages upgrading the Simplon line, a section of the Paris-Lausanne-Milan axis.

The new transalpine rail links are designed to promote traffic between North and South. The Swiss government has decided to build two of them at a cost of SFR 12 billion to benefit from the short-term regional effects of construction. Work is due to be completed in 2010. The project was approved by Swiss voters in a referendum held on 27 September 1992. Evaluation of the links, however, is being undertaken by the companies directly involved in the projects.

All these axes are shown on the map below of the European combined transport network.

[18] "Le transport combiné: une voie d'avenir", 4th ATEC Technical Congress, TEC Revue, No 109, November-December 1991, pp. 5-26.

Carte 8 - Map of the European combined transport network[19]

1.3.4. River and canal network

Development of the river and canal infrastructure will take the form of new links mainly in France, Germany and the Netherlands. In France the main problem for the river and canal network lies in the differences in width and depth, with no interconnections between the networks of major rivers and canals. This is highlighted by the map showing the various categories of inland waterway in France.[20]

[19] DESCOUTURES Pierre, " La France dans l'Europe des transports ", Economic and Social Affairs Council, 27 May 1992, map annex, p.48.

[20] DESCOUTURES Pierre, "La France dans l'Europe des transports", Economic and Social Affairs Council, 27 May 1992, map annex, p.29.

Carte 9 - Map of the French river and canal network

- The Seine-Nord (Seine-North) and Seine-Est (Seine-East) link project is to connect the waterways of the North and East with those of the Seine Basin through channels of the same width and depth ;
- The Rhine-Rhône link is to be established through infrastructural work on the Saône.[21]

Carte 10 - The Saone-Rhine link in the context of the major european inland waterways.[22]

- In Germany the Rhine-Main-Danube link, the skeleton of which is provided by the Mittellandkanal, is completed and constitutes a modern axis serving the German ports of Emden, Bremen and Hamburg. It will be extended to reach the industrial areas of the former GDR, (former) Czechoslovakia and Poland.
- The Netherlands are also studying all possible projects for improving existing river links between Rotterdam and the future German network. The planned Twente-Mittellandkanal link would link Rotterdam and the Northern Netherlands with the German network, thereby avoiding the detour via the Ruhr.

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[21] TORMOS Emile, "La liaison Sâone-Rhin à grand gabarit, dernier maillon de l'axe Mer du Nord-Méditerranée", Navigation, Ports et Industries, No 18/91, pp. 9-15.

[22] GRANET Paul, " Le réseau fluvial européen : risque et enjeu pour la France ", Réalités Industrielles : L'Europe des grands réseaux ", Annales des Mines, avril 1991, pp. 31-33.p32

Carte 11 - The Rhine-Rhône link in the European context[23]

Other projects of large scale missing links exist as the "Switzerland subway" which would allow the East and West crossing of Switzerland in 30 minutes. It will reduce the country to a town scale. Feasibility studies are made by the Polytechnique School of Lausanne.

This latter point raises the problem of the scale of the chosen projects. It could be proposed to take into account the time saving criterion but in that case all the T.G.V. and motorway projects would have to be included into the COST 317 assessments. Crossing a border or a physical obstacle could be an other condition. "The transformation of a discontinuous space into a continuous space" by constructing large scale transport infrastructures is a definition which includes all aspects of time saving, border effects linked with physical, cultural, language and financial barriers.

Some studies exist on border effects which show traffic decrease by 5 and even by 20 at the frontier crossing. Reducing these border effects during one generation, upon 15 years, will represent an important traffic flow. Traffic flows are supposed then to be the same on each side of the inland border of the Union but these traffics would precisely go through the fixed links or large scale projects located on these borders.

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[23] GRANETPaul, "Le réseau fluvial européen: risque et enjeu pour la France", Réalités Industrielles: L'Europe des grands réseaux", Annales des Mines, April 1991, p.32.

2. Analysis of methodologies and of case studies in countries participating in the COST 317 project

by Dr. Odile HEDDEBAUT

2.1. Introduction

This comparative study is carried out within the context of a search for the "effects" of the construction and operation of major transport infrastructure projects. This concern has emerged only recently. In the different European countries, decisions regarding investment choices have been based on the principle of cost-benefit analysis. This allowed economists in the 1960s to justify budget decisions "rationally" in terms of investment in transport infrastructure.

This tendency, largely imported from the United States, is based on calculations of economic viability which seek, first of all, to compare the various improvements which might be made to each road link ; then they aim to establish "hierarchies of urgency" among the projects to be undertaken ; finally, these calculations help to define the budgetary envelopes to be assigned to each project. These methods result from the application of cost-benefit analysis, which measures the variation in Public Utility under the assumption of the optimal allocation of revenues.

In view of the observable fact that investments in transport infrastructures can modify the social and economic behaviour of agents in a given territory, without this behaviour having been evaluated in terms of costs and benefits, this approach leads on to a wider analysis of the social and economic consequences, referred to as the "effects", of the implementation of major transport infrastructure projects.[24]

These new assessments are based on the principle of automatic links between infrastructures and development, following a diffusion mechanism (of a Keynesian type) of investment, which is manifested in repercussions affecting all sectors of the economy[25]. This diffusion process is at the origin of numerous simulations of effects using a model based, on one hand, on an analysis of traffic flows and, on the other, on the distribution of the new demand for intermediate consumer goods necessary for the construction of the infrastructure throughout the economic sectors of a region[26].

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[24] CHERVEL M., LE GALL M., "Méthodologie de la planification: Manuel d'évaluation économique des projets, la méthode des effets", Ministère de la Coopération, 1976, 204 p.

[25] BIEHL Dieter, "The contribution of infrastructure to regional development", Commission of the European Communities, Infrastructure Study Group, Luxembourg, 1986, 412 p.

[26] BIEHL Dieter, "The role of infrastructure in regional development". in VICKERMAN R.W., (edit) : Infrastructure and Regional Development. London, PION Ltd, 1991, 209 p.

PLASSARD François, "Les autoroutes et le développement régional"., Paris, Lyon, Economica-PUL, 1977, 341 p.

PLASSARD François, "Les effets socio-économiques du TGV en Bourgogne et Rhône-Alpes". DATAR/INRETS/OEST/SNCF, 1986, 20 p.

PLASSARD François, "Le transport à grande vitesse et le développement régional". CEMT, 1992.

Analysis of the relationships between infrastructures and development leads on to the concepts of the "structural effects"[27] of the transport infrastructure, which were widely studied in the years from 1975-80. This research argues that construction of a large-scale transport infrastructure (especially a motorway or a high-speed rail link) must "automatically" provoke a series of consequences for the economic and social development of the region which receives the new infrastructure.

In the case of France, this research, together with the need to respond to the new need for socio-economic evaluation of the major transport infrastructures contained in the LOTI[28] of 1982, caused the Direction des Routes to request SETRA[29] to issue guides with recommendations for carrying out these evaluation exercises[30].

The decade of the 1980s also saw a sharp rise in the activities of the Political Sciences concerned with the evaluation of public policy[31] ; these called into question the methods used to assist decision making, which had always been based on a cost-benefit approach.

During the same decade of the 1980s the principle concerning the automatic nature of the "structural effects" of transport infrastructures was vigorously disputed[32]. Researchers noted in fact that discounted effects are not manifested systematically as soon as a new transport infrastructure is constructed. Moreover, they foresaw that the "effects" can be more or less diffuse, and can depend on the mobilisation of local actors to achieve the targets defined at the outset. Thus, the definition of the consequences of the implementation of major transport infrastructures is evolving, and is giving way to a notion of "conditional structural effects"[33].

PLASSARD François, "Axes autoroutiers et développement des régions". Cahiers Scientifiques du Transport, N° 22, 1990.

GRECO Transport et Espace, "Les effets indirects des transports interurbains, Paris, IRT, 1980, 91 p.

27 BONNAFOUS Alain, PLASSARD François, "Les méthodologies usuelles de l'étude des effets structurants de l'offre de transport", in Revue Économique, N°2, 1974, pp: 215-221.

BONNAFOUS Alain, PLASSARD François., SOUM D., "La détection des effets structurants d'autoroute. Application à la vallée du Rhône.", in Revue Économique, N°2, 1974, pp: 215-221.

28 LOTI: Law no. 82-1153 of 30 December 1982 for Orientation of Inland Transport, published in Journal Officiel of 31 December 1982.

29 SETRA: Services d'Etudes Techniques des Routes et Autoroutes

30 Direction des Routes du Ministère de l'Urbanisme, du Logement et des Transports, SETRA, "Instructions relatives aux méthodes d'évaluation des investissements routiers en rase campagne", 14 March 1986, 63 p.

31 BLOY Eddy, BONNAFOUS Alain, CUSSET Michel, GERARDIN Bernard, "Evaluer la politique des transports", ed. *Economica*, 1977, 102 p.

NIOCHE Jean Pierre, POINSARD R. (eds.), "L'évaluation des politiques publiques", ed. *Economica*, 1984

PLASSARD François, "Suivi des évaluations, évaluation des suivis", *Les Cahiers Scientifiques du Transport*, no. 11/12, 1985.

THOENIG Jean Claude, "L'analyse des politiques publiques", in *Traité de Science Politique*, Madeleine GRAWITZ and Jean LECA, vol. 4, P.U.F., 1985.

32 OFFNER Jean Marc, OLLIVIER-TRIGALO Mariane, "Les grands projets de transport. Langages de l'évaluation, discours de la décision". INRETS Synthesis no. 10, November 1987;

33 GAUDARD G. et al., JEANRENAUD Claude et al., "Méthodes d'analyse des effets structurants des grands infrastructures de transport", study carried out within the framework of the COST 317 project, University of Fribourg, University of Neuchâtel, May 1992, 52 p.

This new approach justifies the elaboration of a "back-up strategy", especially in the case of the cross-Channel fixed link.

In fact, the relaunching of the project for constructing such a link, very soon after the decision to abandon the previous project, helped to promote the idea - already sketched at the time of the previous attempt in 1973-75 and in a straight line with the ideas put forward within the guiding framework of OREAM Nord - that it was **necessary to implement a back-up strategy** in very many areas, such as those complementing the transport infrastructure, economic development, research and organization of training, enhanced tourist amenities, protection of the environment, etc.

This strategy is strongly recommended in the report by the American consultancy BECHTEL,[34], which was consulted on this matter by the regional council of Nord-Pas de Calais, at the time when tenders were invited by the French and British governments for construction of a fixed link across the strait of Pas-de-Calais. The strategy was then set out and further developed in a document presenting the tools and means needed to accompany such a project for a fixed cross-Channel link.[35] On one hand, it set out means of economic and social development, such as the initial and on-going training of personnel, stimulating the economy through emphasis on research, putting in place specific economic facilities, developing tourism, enhancing the standard of living and the environment. On the other hand, it advocated a reorganization of communications in the regions to help disperse the traffic and repercussions from the fixed link throughout the Nord-Pas de Calais region.

This reorganization concerned transport infrastructures such as harbours, with the creation of new docks, and the restructuring and modernisation of ports ; rail infrastructures were to be improved with the construction of the northern European T.G.V. line ; electrification of intermediate sections would facilitate service to regional towns - for example, by the Lille metropolitan line in conjunction with TER, and by the national and international network in conjunction with the T.G.V. Road infrastructures were to be enhanced with the completion of the A26 motorway, construction of the A16 and of the coastal bypass and the bypass east of Calais, to unblock the coast and the mining basin.

These measures were to take the contractual form initiated by the decentralised planning inaugurated in 1982 so that they could be included in the new budgetary provisions of the State and the Region.[36] This arrangement reflected a political "voluntarism" and a commitment by the various local decision-makers and regional authorities ; it supported the idea of the non-automatic nature of the positive repercussions flowing from major transport infrastructure projects, and of their structural effects on the territory concerned. This point was taken up, moveover, both by the regional researchers,[37] who maintained that the tunnel could become the basis of a new deal for the region, and by the studies of the Observatoire Economique des Statistiques des Transports (OEST), which recommended the development

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[34] BECHTEL-France, "Impacts et perspectives pour la région Nord-Pas de Calais du lien fixe transmanche", Conseil Régional Nord-Pas de Calais, Lille, August 1985, 217 p.

[35] Conseil Régional Nord Pas-de-Calais, "Lien Fixe Transmanche: Eléments pour un plan de développement de la région Nord-Pas de Calais", Lille 20 January 1986, 35 p.

[36] "Plan Transmanche", draft agreement between State and Region of Nord-Pas de Calais, 14 March 1986.

[37] BARRÉ Alain, "Le Tunnel sous la Manche: une nouvelle donne pour l'aménagement régional", Hommes et terres du Nord, 1988 1-2, pp. 6-12

of a back-up strategy as one of the preconditions for full economic exploitation of major transport infrastructures.[38]

The difficulty of evaluating the consequences of a major infrastructure project, especially when it is introduced in the context of implementing new public policies to take advantage of complex transport infrastructure systems, induced the European authorities to encourage research in this field. Indeed, in order to bring together all aspects of these effects and to try to set up methodologies enabling comparisons on the European plane, this research (in progress) on "the socio-economic effects of the Channel Tunnel" (COST 317) is being carried out within a framework of European scientific and technical co-operation.

From this standpoint the research adopts a comparative approach to the methodologies used and to case studies in France, Spain, Switzerland, Denmark and the Netherlands. It demonstrates the existence of a multiplicity of methods for evaluating major transport infrastructures in Europe. It also stresses the importance of better understanding of the direct and indirect, spatial and temporal effects generated by the construction and operation of major infrastructures which eliminate missing links on a European scale.

In the following case studies in the different countries, a reading grid has been set up in ordre to make some comparisons between all themethods applied in these countries.

This grid systematically indicates the length of the study when mentioned. It presents the objectives of the study and they can be various. It shows the methods used and the approaches to understand the impact phenemenoms are often different from one country to another. It makes a list of observed indicators in each case. It presents the results of the study and stress the weak points linked to either the approaches, the choice of indicators or the results interpretation.

[38] GAC Georges, HUART Yves, CHETANEAU Véronique, "La valorisation économique des grandes infrastructures de transport", OEST January 1989, 101 p.

2.2. Case studies and methods used in France

Concern over the impact of major transport infrastructures in France is a relatively recent phenomenon. For a long time, and in accordance with a well-established tradition since the 19th century "economist-engineers" school, evaluations of major construction projects have been limited to calculations of economic and financial viability.

It was only in 1976[39] that legislation formally acknowledged the need to perform a study of the impact of a transport infrastructure and incorporate it in the public enquiry file before any declaration was made to the effect that the project was in the public interest. This represented the culmination of legislative work arising from discussion on the environmental impact of such projects. The legislation sets out the conditions for performing the impact study but the socio-economic and environmental indicators to be observed are not defined with any precision.

As the law has been applied, a number of deficiencies have been noted. The impact study is the responsibility of "the public or private awarding body, and thus conducted at its convenience, without precise instructions on the methods and tools to be used for evaluating the impact on the environment and on the economic and social fabric. In addition, even though this was called for during discussions prior to adoption of this law, no obligations can be imposed by the conclusions of the impact study or by comments incorporated after publicity of the study. Nor is there any obligation to apply the impact study to all possible variants, before the definitive variant is chosen. No consideration is therefore given to the principles of multimodality and intermodality."[40] This in itself would justify the adoption of a new law concerning the impact of major transport infrastructures.

LOTI, the Inland Transport Development Act adopted in 1982[41], brought in new principles for assessing the impact of major transport infrastructures. It makes an "ex-ante" and an "ex-post" economic and social evaluation of the project compulsory. It also clearly emphasizes the principles of multimodality and intermodality. Finally, the decree covering its implementation[42] brings in fresh clarification concerning the socio-economic or transport indicators to be incorporated into the evaluation and assessment process.[43] Nevertheless, this new law has some serious shortcomings as regards drafting, content of the evaluation and conditions for carrying it out. It should be noted, however, that the environmental component is no longer even quoted in the final impact assessment.

Article 8 of the implementing decree of 17 July 1984 laying down methods and indicators to be used in transport infrastructure assessment states that "the overall economic and social impact assessment of the infrastructures under evaluation shall be drawn up by the awarding authority at least three years and at most five years after the infrastructures concerned have

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39 Law No 76-629 of 10 July 1976 on nature conservation, Official Journal of 13 July 1976, pp.4203-4206.

40 O. Heddebaut, G. Joignaux, "L'évaluation environnementale des infrastructures de transport: des pratiques difficiles à mettre en ÷uvre", communication to ASRDLF symposium, Tours, 30-31 August and 1 September 1993, 20 p.

41 Law No 82-1153 of 30 December 1982 (Inland Transport Development Act), published in the Official Journal of 31 December 1982.

42 Decree No 84-617 of 17 July 1984, applying Article 14 of LOTI.

43 These indicators are set out in the case studies below.

been put into operation. The gathering of information needed for the assessment shall be organized by the awarding authority at the beginning of the project". This passage confirms that no account is taken of the environmental impact.

In addition, Article 5 of the decree again assigns the responsibility for infrastructure evaluation to the awarding authority, as was the case in the law of 1976 : "Evaluation of a major infrastructure project shall be the responsibility of the awarding authority and shall be financed by the same." This role of "judge and party" of the awarding authority is also emphasized in Article 8 of the decree : "The assessment (...) shall be drawn up by the awarding authority". The article even has a restrictive character as the assessment can only identify the short-term effects (up to five years). By definition, therefore, it excludes the long-term effects. This is also reinforced by the decree : since the financing of the assessment is to be borne by the awarding authority, the latter will have every incentive to complete it in a three-year period after the infrastructure becomes operational, as authorized by the decree, whereas LOTI provides for a five-year period.[44]

It should also be noted that the law and the decree provide for "ex-ante" and "ex-post" evaluation for major infrastructure projects and choices of technology (TGV versus conventional trains ; bridge versus tunnel ; fast inter-city train versus suburban motorway, etc.).

Ten years' experience of applying this law and its implementing decree, a number of protest actions and movements regarding major infrastructures and the rise of "green" attitudes in France have caused politicians and planners to look at the deficiencies of the law or its actual conditions of application. Between 1991 and 1993 there has been a proliferation of discussion groups on the approach and methods to follow for more effective identification of the impact of major transport infrastructures.

At the end of 1990, six ministries assigned the National Planning Board the task of organizing and chairing an interdepartmental think-tank on transport. Christened "The Transport 2010 Project", it recommends that consideration be given first of all to planning and national and regional development strategies within the European context, then to transport infrastructures as one means of achieving these planning targets rather than a goal in itself.

In particular, it recommends that a consensus be found among all interested parties (the Ministries for Infrastructure and Transport, Economic and Financial Affairs, and the Environment) regarding methods for evaluating major projects and calculating viability, and proposes that these methods be reviewed every five years.[45]

Under the "Transport 2002 Project", directed by Mr Gilbert Carrère, there has been wide-ranging national debate on transport infrastructures in an attempt to tackle foreseeable future transport demand in a national strategic context. This would acknowledge the constraints imposed by limited energy resources, environmental protection requirements, criteria governing quality of life, land management and a slowing down of growth.[46]

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44 O. Heddebaut, G. Joignaux, op. cit., 1993.

45 "Transports 2010", report of group chaired by National Planning Commissioner, Paris, La Documentation Française, June 1992, Volume 1/2, 516 p.

46 "Transports Destination 2002: le débat national", report on transport demand and infrastructure strategies, Paris La Défense, 25 February 1992, 323 p.

The first result of this work was the publication in December 1992[47] of a circular making it compulsory to take into consideration the socio-economic and environmental evaluation of all possible variants of the project before choosing the definitive route, and to hold a wide-ranging public debate before taking any decision. It tightens up conditions for the evaluation and clear instructions relating to it are given to departmental prefects. The debate and studies thus prescribed must also cover infrastructure functions in the light of "conditions for management of the land in question".

This was followed by the "LOTI Evaluation Project" of July 1993, which, though not fundamentally questioning the law, proposed a set of improvements to be made with regard to its interpretation and application.[48] It stresses the need for European harmonization in methods for evaluating the costs of using infrastructures and external costs, and attaches great importance to the role of the regions in drawing up global management strategies which determine requirements for construction of transport infrastructures.

The proposals and conclusions of the "LOTI Evaluation Project" are summarized as follows :

- procedures for evaluation and assessment of economic, environmental and social findings carried out in conjunction with the awarding authority ;
- reinforcement and greater involvement of independent representative bodies ;
- search for intermodal efficiency ;
- preparation of multimodal master plans ;
- giving the regions a bigger role in the transport field ;
- need for European harmonization in methods for evaluating the costs of using infrastructures and external costs ;
- amend the decree of 17 July 1984 to define more clearly criteria to be taken into account (particularly incorporating environmental factors) and procedures to be followed in infrastructure evaluation and assessment, and to make it applicable in practice to "major technological choices".

Its conclusions show how difficult it is to apply the 1982 and 1984 acts, the spirit of which was in line with most of the report's recommendations. It sets out the need, however, to consider transport infrastructures in an overall planning context, with overall evaluations and assessments of a broader scope than those undertaken at present, in the vicinity of the infrastructures themselves or dividing the projects into sections.

With regard to all the LOTI projects, a large number of reports have been produced by the Centres for Technical Infrastructure Studies and disseminated by SETRA[49] in the form of "recommendation guides" for evaluating and assessing projects. They are designed to achieve harmonization in the way procedures are implemented to provide a solid basis subsequently for comparison of the different projects. These recommendations generally apply only to investments in roads, as the SNCF does not aim for perfect transparency here, unless forced to

[47] See "circulaire Bianco", circular No 92-71 of 15 December 1992 (Infrastructure), NOR: EQUIR9210176C.

[48] Conseil National des Transports, "Rapport sur la situation et l'évolution des transports 1992", Evaluation of LOTI conclusions and proposals, Paris, July 1993, pp.109-117.

[49] SETRA: Service d'Etudes Techniques des Routes et des Autoroutes (road and motorway studies department).

do so as a result of opposition from local residents and/or users. This runs counter to the aims of the legislation to carry out multimodal or intermodal evaluations.[50,51]

2.2.1. The Britanny road scheme

The Morbihan Departmental Directorate for Infrastructure performed a study on the impact of high-speed roads in general with particular reference to the Brittany Road Scheme. This formed part of the socio-economic follow-up to completed transport infrastructure projects required by LOTI[52]. The study contains a number of evaluations of high-speed road and motorway sections forming part of the Brittany Road Scheme[53].

The study involves, first of all, observation of the changes which took place in the vicinity of the major highways over a twenty-year period (1970-1990). Two categories of effects were observed :

2.2.1.1. direct effects of road infrastructures :

- on transport, i.e. reduction and regularity of journey time, improved safety, increased traffic volume (partly due to increased motivation to travel) ;
- on business, via a survey using interviews with company bosses to identify the effects of new infrastructures on their firms' operations ;
- on the environment, comparing the state of sites before and after completion of transport infrastructures, registering the positive effects on the quality and style of life of city-dwellers who benefit from redirected traffic with reduced air and noise pollution.

2.2.1.2. indirect or secondary effects of road infrastructures :

- on short-term and long-term local employment by identifying new ways for local firms to operate, with the possibility of increased sales from reduced transport costs or a better competitive position, thereby enabling them to increase their production capacity ;
- on the siting of companies, by assessing the impact of the infrastructure on decisions regarding the location of new establishments ;
- on tourism, by conducting surveys with motorists from Paris using the RN 157 near Rennes, and with inhabitants of Rennes on weekend trips ;
- on the landscape, by recording the essential features of typical Breton landscapes and comparing the changes arising from the construction of new roads in the local environment.

Secondly, the study analyses back-up measures taken by State, Department or local district in order to evaluate how they can reinforce the beneficial effects of new road infrastructures and tackle their negative impact.

As regards direct effects, the results of studies show an increase in traffic flows on the roads involved in the Brittany scheme as and when they have been upgraded or constructed.

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50 Direction des Routes, "Instruction relative aux méthodes d'évaluation des investissements routiers en rase campagne", 14 March 1986, 63 p.

51 CETE de Lyon, SETRA, "Evaluation économique des projets routiers interurbains, (Article 14 de la Loi d'Orientation des Transports Intérieurs LOTI du 30 décembre 1982), guide de recommendations", May 1988, 70 p.

52 B. Guitard, A. Plaud, "Impacts et mise en valeur des voies rapides", Morbihan DDE, June 1991, 26 p. + Annexes.

53 CETE OUEST, "Evaluation de la RN 137 Rennes-Saint Malo (mise à deux fois deux voies)", 1990, 127 p.

Between 1973 and 1986 traffic doubled on the southern dual carriageway route, while there was only a 50% increase throughout the national network.

The surveys of company heads show that they regard the infrastructures as being responsible for increases in business trips, safety and reliability of transport, shorter delivery deadlines and expansion of market territories.

The building or upgrading of infrastructures has increased the commercial attractiveness of Rennes city centre and heightened mutual competition between various urban focal points.

As regards secondary effects, the study notes growth in employment in Brittany between 1968 and 1982, mainly along the dual carriageway routes. But it plays down the cause-effect relationship by noting that these routes serve coastal areas with other plus points to help their development.

As regards the siting of companies, it would appear impossible to quantify how much the existence of road infrastructures influences choices of location. In fact, the quality of transport accounts for about 11% in decisions regarding location but [road infrastructures] "play a lesser role than factors relating to the workforce (quality, size and behaviour) and company environment (equipment and services, existing industrial fabric)". This corroborates the SETRA findings on identifying the indirect economic effects of major road infrastructures[54]. The study concludes that locations are mainly chosen in key areas not far from the junctions serving them.

Here it is worth pointing out that this growth in employment probably owes much to the impact of the policy for aiding industrialization in western France. The latter comes within the context of major French planning decisions dating from the 1960s. It ties in with the gearing of industrial planning strategies in the 1960s and 1970s to specific locations, influenced by Taylorian logic applied on a large scale to the consumer goods industry and by the intensive growth in industrialization of the agri-food sector. Fresh movements of goods and persons have been generated, with new forms of spatial distribution of the population and the emergence of principal and secondary cities.

The increase in the transport infrastructure supply provides an appropriate answer to the additional demand generated in this way.

It is impossible to separate analysis of the effects of the Brittany road system from appraisal of industrial planning and development policies over the same period. There is clear interaction between infrastructures and their expected impact, on the one hand, and regional development policies and their effects, on the other, studied in the context of socio-economic evaluation.

Surveys of tourists' destinations conducted on the major routes of the Brittany Scheme show that inhabitants of the Paris region have either increased the frequency of their stays in Brittany (27.4%), or changed their choice of destination (28.8%), or both at the same time (13%). In addition, people from Rennes questioned during weekend trips have for the most part extended the range of their leisure destinations as a result of improvements in accessibility. Finally, the study comments that this improved accessibility is encouraging a

[54] SETRA, SEMA, "Etude des effets économiques indirects des investissemnts routiers et autoroutiers", August 1976, May 1978.

growing number of city-dwellers or people from outside the region to build or purchase second residences in Brittany.

The study records a number of back-up measures adopted to complement the effects of the new routes. Some measures, of a "traditional" nature, relate to the construction of the infrastructures themselves (information to users, goods depots, HGV service areas, feeder services networks, etc.). Other measures, such as joint development programmes involving State and Region and the creation of zones of activity, are implemented to increase the economic benefits. Finally, there are specific measures for promoting tourism in Brittany (publicity material, theme tours, etc.).

Evaluation of the "Brittany Road Scheme"

Period of the study	1990-1991
Authors of the study	Morbihan DDE, responsible for implementation and operation of Brittany Road Scheme.
Objective of the study	- To evaluate the impact of the Brittany Road Scheme (PRB) for the twenty-year period (1970-1990) after its conception ; - To identify the impact of high-speed roads, including motorways, on a general scale and for Brittany in particular ; - To analyse the effects of regional strategies for maximizing positive effects and alleviating negative effects of the various PRB infrastructures.
Methods used	- Estimate of primary effects of high-speed roads by observation of changes in passenger and goods traffic movements for Brittany ; - Estimate of secondary effects of PRB on : - Local economic development, by conducting surveys in industry and commerce ; - Tourism, by conducting surveys of Parisians driving near Rennes and of Rennes inhabitants on weekend trips ; - The landscape ; - Evaluation of back-up measures implemented in relation to transport to derive economic benefits and preserve the environment.
Indicators observed	- Gains of time and accessibility in relation to junctions, levels of safety and user comfort, transport costs and flows ; - Socio-economic structures of Morbihan by sector ; - Revenue, short- and medium-term labour market, siting of firms, tourist numbers.
Results	- In 20 years, 68% of the PRB has been achieved. Completion is due by 1997. - Direct effects : overall increase in traffic flows on new/improved roads, operational improvements for firms due to road transport improvements, enhanced commercial attractiveness of Rennes ; - Secondary effects : growth in employment along major PRB routes, siting of firms near to major economic poles and road junctions, expansion of tourism ; - Importance of back-up measures linked to infrastructure programme is stressed. Role of local players (regional and departmental bodies) enables positive impact of road programme to be enhanced.
Weak points	- Morbihan DDE's "judge and party" role ; - Underestimation of significance of road development for wider context of general planning policies.

Table O. HEDDEBAUT

2.2.2. Evaluation of the impact of the A16 motorway

It is interesting to look at how economic, social and environmental factors are taken into account in the construction of the A16 motorway, which by definition is covered by the legal obligations contained in the LOTI law of 1982 and its implementing decree of 1984.

The aim of the motorway is to form a link between the Belgian frontier and Paris along the Nord/Pas-de-Calais coastline. This so-called "coastal bypass" forms part of the "cross-Channel planning contract" and represents one section of the "south-west corridor" of the "cross-Channel road scheme"[55] designed to link Nord/Pas-de-Calais, Picardy and Upper Normandy, thereby reducing the isolation of western France and distributing the traffic bound for Spain which building of the Tunnel and opening up of the Community's internal boundaries are expected to generate.

The new infrastructure thus forms part of a larger scheme providing a connection with the Atlantic ports and will therefore be the "river-link motorway" provided for in the "National Road Outline Plan", approved on 5 November 1990.

A committee run by CETE and SETRA has been monitoring the socio-economic effects of the A16 motorway, in particular the section between Amiens and l'Isle Adam just outside Paris. A battery of indicators has been drawn up and applied, in accordance with recommendations in the annexes to the 1984 decree implementing the LOTI act of 1982.

They cover the 1992-1997 six-year period, with the focus on 1994, the probable opening date for the motorway. They are concerned with two major fields : transport and socio-economic aspects. How the "environment" variable is beginning to play a role in the evaluation of road infrastructures will be analysed below.

2.2.2.1. Transport

To observe changes in road supply and demand with regard to passenger and heavy goods vehicles, automatic counting on primary roads and "ex-ante" and "ex-post" campaigns on regional roads are used. The range of observation covers measures for upgrading the network of roads which interconnect with the A16 and allow access to the junctions. As regards inter-city coach transport, annual analyses supply information on supply and extent of use.

To evaluate changes in the quality of service, the method adopted is to observe fluidity by recording traffic at peak hours, frequency and size of traffic jams, safety in terms of the number of accidents during a year, and journey times by on-the-spot measures and surveys of starting points and destinations.

The functions of the existing network will be followed by updating in 1994 the surveys of starting points and destinations conducted on the RN1 between Amiens and l'Isle Adam.

Finally, rail and air travel are being analysed in terms of customer numbers and traffic volumes.

2.2.2.2. Socio-economic aspects

The method used in this field is based in particular on data from municipalities and districts for an observation range of ten kilometres around interchanges.

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[55] "Plan routier transmanche", Direction des Routes, January 1986, 29 p.

A comparison between figures recorded for growth in the population and the number of households (1968-1990) and in the number of building permits supplies data on the demographic evolution of the area being studied.

As regards direct employment created by the infrastructure, the method records the number of jobs on the construction site and the number necessary for operation of the infrastructure. By consulting the Assedic and Unedic files, it also observes changes in the number of salaried employees in the private sector and the rate of unemployment.

The effects of the A16 are monitored for different sectors of activity :

- The effects on agriculture are evaluated by examining modifications to the land-use plan, reductions in land requirement, and production. A postal survey of the agri-food industry in 1993, to be repeated in 1997, supplies data on catchment areas and market territory and on supply and distribution circuits.
- A survey via questionnaire is expected to demonstrate the role of the infrastructure in changing relationships between authorizing officers and subcontractors in other branches of industry. A study of the INSEE Sirène file regarding building permits and a survey of motives gives information on new firms established since the public enquiry, in particular changes of location.
- Effects on transport firms are estimated by monitoring the number of firms involved, changes in vehicle fleet numbers and in the average distance travelled.
- The impact on tourism is evaluated by recording the number of building permits for second residences, local tourist capacities (accommodation types and facilities for eating out), and data from the tourist boards on "site-oriented tourism".
- Effects on commerce are analysed through discussions with hypermarket managers to find out their customer territory, plans for expansion and reasons for their choice of location. A survey of the number of establishments on the RN1 in 1993 and 1997 should give indications for small retail businesses.

Analysis of back-up measures and policies to welcome new firms in particular is based on observation of zones of activity (establishment and expansion), local authority groupings, tax incentives, amendments to planning documents, and the construction of feeder infrastructures, with attention to changes since the public enquiry and monitoring on an annual basis.

Finally, the financial impact of the A16 is calculated in the light of the viability of the project for the State and the contracting firm. It is interesting to note that the methods used to determine a motorway's financial viability (for the State) differ according to which point of view is adopted : that of the Roads Directorate of the Infrastructure Ministry or that of the Planning Directorate of the Financial Affairs Ministry[56].

Locally, analysis of land and occupational taxes is the basis for a record of new taxes imposed by local authorities.

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[56] This is given particular emphasis in Atelier No 3, "Politique des transports et financement du système de transports", part of the National Planning Board's "Mission Transport 2010", in "Transports 2010", report of the working party chaired by the Planning Commissioner, Paris, La Documentation Française, June 1992, Volume 1/2, 516 p.

2.2.2.3. Environmental aspects

There is no provision for monitoring environmental variables, which is logical enough as it is not envisaged in the legislation for applying LOTI. What is curious, however, is that the infrastructure will not be evaluated in the same way throughout its length.

As regards the motorway section between Amiens and Boulogne-sur-Mer[57], for which the declaration of public utility was signed on 15 July 1992, it is planned to set up a "group of recognized experts in the field of the environment" under the authority of the Prefect of the Region with the task of "setting environmental protection objectives and monitoring progress". This environmental monitoring committee must be funded to the tune of 1% of the project cost and operate for the period of the work, i.e. about four years.

As soon as it goes into service, this stretch of motorway will be covered by the legal framework of monitoring and reports as described above and will therefore no longer be subject to scrutiny for its environmental impact. Even though the declaration of public utility adds that "special attention will be given to sensitive sectors and to conservation of flora and fauna, and the impact will be monitored during and after putting into service and, if necessary, corrective measures taken", it is not yet clear what form such monitoring would take. There would appear to be strong recommendations in this direction in the circular of 15 December 1992 signed by the same ministry.

These modifications reflect changing attitudes towards the environmental aspect of transport infrastructure evaluation. The means for expressing the new thinking in practice are limited, but the positive developments are reinforced by supportive political attitudes, in particular in Nord/Pas-de-Calais.

[57] This is the third and central section of the A16. The first section (between the Belgian frontier and Boulogne-sur-Mer) was opened on 15 June 1993. The second section (between Amiens and Paris) is due to open during 1994.

Evaluation of the impact of the A16 motorway

Period of the study	1992-1997
Authors of the study	CETE Nord Picardie and SETRA (funded by SANEF[58], contractor for the Boulogne-sur-Mer-l'Isle Adam section)
Objective of the study	- To monitor the impact of the A16 motorway in the form of an "ex-post" evaluation no later than five years after its opening, in line with legal obligations imposed by LOTI ; - To analyse the effects of regional strategies implemented to maximize positive effects and alleviate negative effects of the A16.
Methods used	- Monitoring of primary effects of A16 motorway in the transport and socio-economic fields ; - Estimate of secondary effects of A16 on : - Local social fabric and economic development, by monitoring numbers of salaried employees in the private sector and rates of unemployment, and by conducting surveys in industry and commerce ; - Tourism, by monitoring tourist board data on tourist numbers and facilities ; - The environment, with regard to the Boulogne-sur-Mer-Amiens stretch, by setting up a committee to monitor the environment during the construction period ; - Evaluation of back-up measures implemented in relation to policies for welcoming firms to provide economic benefits.
Indicators observed	- Gains of time and accessibility in relation to junctions, levels of safety and fluidity, transport flows ; - Socio-economic structures by sector, with an observation range of about 10 km from motorway junctions ; - Short- and medium-term labour market, siting of firms, industrial estates, tourist numbers.
Results	Not yet published (still pending)
Weak points	- Observation of impact of A16 over a short (3-year) or medium (5-year) period, thereby eliminating "structuring" effects identifiable over longer periods ; - Difficulties of implementing environmental monitoring.

Table O.HEDDEBAUT

[58] SANEF: Société des Autoroutes du Nord et de l'Est de la France

2.2.3. the Lyon-Paris TGV impacts[59]

2.2.3.1. Study of the effects of the Lyon-Paris TGV on activities

The bringing into service of the TGV has not had any immediately obvious, major effects on economic activity, as far as industrial location or the creation of jobs is concerned.

i) Activities linked with the traffic

Through the changes in mobility resulting from its being brought into service, the TGV has had immediate effects of reducing the level of activity in the hotel, catering, travel agency and road transport industries.

The first consequences of the TGV for the hotel industry are connected with the reduction in the duration of journeys starting from the Paris region, as the number of journeys without a night away has increased from 20% to 50%. However, all in all, the trends in the hotel industry are contradictory. Some hotels have seen the fall in the number of business clients offset by an increase in tourism aimed at businessmen.

Various catering establishments have benefited greatly from TGV clients, where necessary adapting their hours to the timetable of train arrivals and departures.

Some travel agencies are doing more rail ticketing, because of the need for reservations on the TGV, and also no doubt because of the increase in mobility of clients used to obtaining tickets from agencies.

Finally, the arrival of the TGV is often beneficial for complementary transport: taxis, bus operators serving neighbouring towns, car rental firms.

ii) Other activities

The possible effects of the TGV on the location of industry, on tourism and the property business are passed on through the behaviour of economic operators, and as such there is no question of this being automatic. And the inertia of this behaviour seems to be much greater than that of mobility practices.

a) The location of industries

Only a few cases of new activities being located as a result of the arrival of the TGV could be found. The economic crisis no doubt explains this low level of new establishments and makes it impossible to draw any general conclusions. In all of the cases, the reasons are not connected with the TGV by a simple cause-and-effect relationship. The development logic of the firms is linked much more closely to the trends in their branch or sector rather than to developments in the means of transport.

A number of factors seem to apply to possible locations, in an order which is specific to each undertaking or each location:

- the availability of a building,
- classification as redevelopment zone,
- the quality of the living environment and the possible foil effect of the Paris region,

59 This chapter on the impacts of the South East TGV is due to Franois PLASSARD, Chairman of COST 317 and Research Director at ENTPE

- and only then is the presence of the TGV cited as a reason for location.

b) A particularly sensitive sector, the Consultancy and Support Practices

One sector tends to dominate all the others, that of Consultancy and Support Practices (ECA). Indeed, it accounts for 1882 trips a day on average in 1985, compared with 804 in 1980, that is an increase of 130%. The sensitivity of these undertakings to the existence of the TGV is not the same, depending on their strategy: it is the very dynamic regional firms which seem to have taken particular advantage of the TGV to focus on the Parisian market. In Paris they have sought out the custom of the medium-sized enterprises with which they are familiar.

c) Tourism

It is group tourism which has benefited most from the new rail service. The development of these activities has happened on the initiative of people working in the industry, local authorities, transport companies or travel agencies. However, the results of these initiatives have been uneven, with some ending in failure, and others producing tangible results. Success or failure seems to depend not only on the goodwill and dynamism of the participants, but also on the existence of strong tourist potential.

It has been impossible to detect any change in the behaviour of households; the most that could be mentioned is more frequent stays by owners of appartments in winter-sports resorts. However, the resorts served by the TGV have not seen a more rapid increase in the frequency of visits than resorts which do not have a TGV service.

d) The property business and town planning

As far as the property business and town planning are concerned, the consequences of the TGV are not yet clear. Certainly car parks have been built or laid out in the areas around stations, some of which have been modernised, sometimes as part of ambitious town-planning operations such as at Valence. However, in all cases it can be said that this has happened at the time of rather than because of the arrival of the TGV.

Study of the economic effects fo the TGV South-East link

Length of the study	one year (1985)
Authors of the study	Laboratoire d'Economie des Transports [Transport Economics Laboratory] InterAlp
Objective of the study	- To discover the consequences of the opening of the Lyons-Paris high-speed rail line for the location of industry, tourism and the property business.
Methods used	- Undirected interviews among the various economic, political and institutional players.
Indicators observed	No systematic use of indicators
Results	Main result: high sensitivity of higher tertiary activities to the transport conditions and quite specifically to the rapid means of transport (aeroplane and TGV).
Weak points	- Studies carried out within too short a period following the opening of the line: the anticipated effects would develop over longer periods. - Effects detected are too tenuous for them to be easy to apply generally.

Table F. PLASSARD

2.2.3.2 Study of the changes in business mobility

The Laboratoire d'Economie des Transport has studied the change in business mobility. In order to do so, it carried out two comparable surveys on this type of travel between Paris and the South-East in 1980 and 1985, that is just before and a little more than two years after the line was brought into full service. From the uses which have been made of it, it is possible to define the content of this form of mobility better. However, the comparison of the results in particular shows up the changes in behaviour attributable to the entry into service of the TGV[60].

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60 The 1980 survey was carried out by Alain BONNAFOUS, Danièle PATIER and François PLASSARD who were also responsible for the data processing. The 1985 survey was carried out by Danièle PATIER and François PLASSARD. Jean-Louis ROUTHIER was responsible for establishing the data files and François PLASSARD for operation.

i) The changes in mobility

The first observation to emerge, which has been emphasised by all observers, is the sharp growth in the number of business trips, much more marked departing from Rhône-Alpes than from the Paris region.

A situation in which distribution was more or less evenly balanced between aeroplane and train before the TGV has been followed by a situation in which the train has recovered more than 80% of journeys. Mobility by plane has fallen by about 50%, whereas mobility by train has more than doubled. About 25% of journeys made by TGV would not have been made without it.

The growth in the number of trips observed in an average day is confirmed by the replies to the surveys on their annual mobility according to means: a fall of 40% in air traffic can be seen, together with an increase of more than 100% in rail traffic. On the other hand, mobility by car has increased only very slightly, probably because of transfers to the train.

The increase in mobility can be explained more by an increase in individual mobility rather than by an increase in the number of people who are travelling.

The bringing into service of the TGV has, above all, led to an increase in individual mobility; everything points to individuals making several short trips, instead of one long trip. As such the TGV has not resulted in a new form of mobility but, for a large number of people, has transposed to rail a form of mobility hitherto reserved for air travellers.

ii) The reasons for travelling

The main reason for the trips is to meet another person; purchases and sales only come afterwards. This structure changed very little between 1980 and 1985. However, it is noticeable that the share of services and contacts within the undertaking or group increased, whereas the share of contacts outside the undertaking fell slightly.

The increase in the number of trips masks a change in the behaviour of users; instead of organising one trip to Paris with several meetings, business people now make several trips with only one meeting. Thus, to some extent the increase in mobility would not mean that the travel has a new economic content, but rather that travel is becoming more and more commonplace, especially departing from Lyons. There is less and less hesitation about making a journey, even one that has not been planned in advance. The spontaneous comparisons which some heads of firms have made between the TGV and RER (high-speed surburban branch of the Paris metro) are indicative of this state of mind.

Study of the changes in traffic attributable to the South-East TGV

Length of the study	- an initial survey of rail and air transport in 1980 - a second identical survey in 1985
Authors of the study	Laboratoire d'Economie des Transports (Lyons) [Transport Economics Laboratory]
Objective of the study	- To find out the consequences of the opening of the Lyons-Paris high-speed rail line for the location of industry, tourism and the property industry.
Methods used	- Surveys one average weekday
Indicators observed	- details of the journey (origin, destination, frequency, reason) - details of the traveller and position within the firm
Results	- Good assessment of the trends in business mobility and transfers between modes.
Weak points	- Not possible to integrate road traffic into the comparison between the developments in rail and air traffic. - The observed effects seem to be specific to the Lyons-Paris link.

Table F. PLASSARD

2.3. Case studies and methods used in Spain

Since the 1960s Spain has been seeking to establish a methodology for evaluating investments in transport infrastructures[61]. Initial studies compared the operating costs of one infrastructure with those of another in order to make choices regarding investment between different modes of transport. At the end of the 1960s the Higher Council for Inland Transport, working with the Highways Department and the World Bank, drew up investment manuals for road and rail infrastructures. These are based on cost-benefit analysis and have only been applied in a few cases.

In the 1970s, the work of the [Spanish] Inter-Ministerial Commission for the Evaluation of Public Investment Projects culminated in the compiling of a "general methodology for evaluating public investment projects". This is based on a classification of the costs of different projects. The "primary" costs comprise the direct and associated costs ; the "secondary" costs are quantifiable but distinct from the former, or are "intangible" when it is not possible to quantify or assess them in monetary terms. The same approach is applied to benefits. This methodology also attempts, especially in the case of road investments, to consider the impact of projects on other objectives of economic and social policy and on the environment, in addition to their financial or economic viability.

In practice, application of this method has hardly gone beyond the level of cost-benefit analysis, a circumstance which caused the Institute for Transport and Communications Studies (IETC) in the mid-1980s to carry out a study of the organization and evaluation of investment in transport. This new approach proposed three types of evaluation.

1. Financial evaluation integrating the effects of the project on the operating company by observing the flow of revenue and expenditure throughout the lifespan of the project, and by comparing the situations "with" and "without" the project.
2. An economic analysis which maximises the "surplus" realised by consumers and producers (savings in time and safety) and the gain in accessibility ; the methods of calculation are defined by the Roads Directorate (Direccion de carreteras) of the Ministry of Public Works.[62]
3. An analysis of social viability mainly concerned with the effects of investment on social groups from the point of view of distribution. In addition, social viability includes impact on the environment, atmospheric pollution, noise, effects on employment, energy consumption, technological stimulus, etc.

The totality of these effects is accounted for, within this general methodology, by means of two main indicators : the generation or reduction of employment during the construction and operation stages of the project, and the effects on the distribution of income.

Some case studies which have been carried out show how this attempt at a methodological evaluation of infrastructure effects is put into practice.

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[61] SECEG, "L'évaluation des effets socio-économiques des infrastructures de transport en Espagne", Rapport préliminaire sur l'analyse d'expériences, Document de travail pour le groupe COST 317, Bruxelles, Avril 1991, 13 p.

SECEG : Sociedad española de Estudios para la Comunicacion fija a traves del Estrecho de Gibraltar

[62] MOPU, "Efectos territoriales: accessibilidad", Plan general de carreteras 1984/1991, Direccion General de Carreteras, December 1984, 69 p.

2.3.1. Indirect Effects of the Construction and Operation of Motorways[63]

In the mid-1970s a study was commissioned by the General Roads Directorate of the Ministry of Public Works with the aim of establishing procedures for evaluating the effects caused by the construction and operation of motorways. A second objective was to find a way of estimating or at least assigning an order of magnitude to the impact of such projects, to identify the different effects flowing from them and to define their relative importance.

The first stage of this method consists in selecting the effects and classifying them, on one hand, in terms of their timing ; these effects comprise "transitory effects" occurring during the construction stage and "permanent effects" occurring during the operation stage. On the other hand, effects are classified in terms of the agencies involved, whether the administration, the users or the community.

The indicators observed ware primarily the revenue and expenditure of the various agents, the volume of transactions carried out and the redistribution of income by the central administration during both stages of the project. Modification of land use is also taken into account, being translated into gains or losses of revenue for the agents, and therefore monetarised. The environmental and ecological effects are cited but are not included in the accounts.

In its second stage the study considers a theoretical example -which, however, is close to the Spanish situation - to try to account in monetary terms for the totality of effects generated by the introduction of motorways.

This textbook case involves a representation of an imaginary country divided into industrial, rural and tourist regions and located within a larger system symbolising foreign interactions.

The indicators observed are now the population structures of each zone and their degree of motorisation, the structures of the production sectors, and the flow of exchanges between regions and with the outside world. Several variants of road axes are then tested in models of the gravitational type to determine the total traffic and the induced traffic which does or does not justify investment in roads.

The limits of the method are reached when it becomes necessary to evaluate the totality of indirect effects, by virtue of their very nature. It is, in fact, impossible to aggregate heterogeneous effects measured in different units. Some are quantifiable in monetary terms, while others are expressed in qualitative terms or by their "degree of importance".

In addition, application of this model requires perfect knowledge of the operation of the economic system represented.

Finally, the transposition of this "ideal" textbook case to reality implies that one has access to complete and reliable statistical databases, that the socio-economic structure is entirely known and that the induced effects do not influence each other reciprocally.

63 DUQUE DE LEZAMA José Luis, GRACIA Carlos Romanos, "Efectos indirectos derivados de la construccion y explotacion de autopistas", Revista de Economia, no. 140, 1977, pp. 75-117.

Indirect effects of the construction and operation of motorways

Duration of study	Late 1970s
Authors of study	General Roads Directorate of Ministry of Public works
Objective of study	• To establish procedures for evaluating the indirect effects of the construction and operation of motorways. • To obtain an estimate of the global impact of the introduction of motorways and to observe the relative importance of different effects.
Methods used	• Detection and classification of the impacts and processes resulting from the introduction of motorways. • Selection of the effects to be evaluated in terms of their type and the greater or lesser ease of recording them. • Representation of a theoretical example, close to Spanish reality, in order to evaluate and quantify the effects of these investments.
Indicators observed	• Socio-economic structures of an "imaginary" country divided into regions, during the construction and operation stages of the projects. • Revenues, labour market, transport costs and flows, industrial sectors.
Results	Application of this textbook case allows the different variants to be classified in terms of their costs, and therefore facilitates decision-making. In the case of each variant, the study predicts development of the regional economy.
Weak points	• The "theoretical" study includes data which are often not available in reality ; it does not take account of effects it is unable to quantify or monetarise. • The evaluation is disconnected from international political and economic contexts and from the planning of European transport networks.

Table O. HEDDEBAUT

2.3.2. Evaluation of the impact of major installations[64]

In the mid-1980s, within the context of the holding of the Olympic Games at Barcelona in 1992, the Research and Planning Centre and the University of Barcelona were commissioned to undertake an economic evaluation of the effects of major investments in public works on that occasion and in that region. The primary concern was with large-scale urban projects connected with the Games, with the relocation of a railway line and with modifications to Barcelona airport.

The study considers three main kinds of effects : firstly, the multiplier effects of investment on the Keynesian model, which identifies variations in revenue in relation to the growth in demand generated by the investment ; secondly, the "sectoral diffusion" effects of investment in public works, which can be measured by input-output tables ; finally, the effects on company location, which express the modifications produced in economic activity and in the relationships between the different agents in the zone influenced by the project.

In order to identify the effects of major installations, the authors advocate making a preliminary diagnosis or defining an "ex-ante" situation, using as indicators the population and its mobility, land use, the property market, economic activity and its structural operation, and the transport system, specifying the infrastructures, services and level of utilisation.

They then carry out an analysis of the economic viability of the investment ; this analysis comprises a financial balance-sheet for the project, a cost-benefit analysis for the agents involved, in terms of accessibility, enhanced economic, commercial or touristic attractiveness of the zone concerned, and the repercussions on the land and property markets.

The application of the classical Keynesian model to the multiplier effect of investment, which considers only the construction phase of projects, assumes a multiplier effect of 1.411 of P.I.B. This factor rises to 1.9 in the MOPRE model, developed from the Keynesian model by the Spanish Economic and Finance Ministry, which integrates subsequent or operational years.

Although there is no standard methodology applicable to the measurement of the effects of large projects, the study arrives at the following conclusions :

1. It is necessary to carry out an analysis of impact or economic viability within an integrated urban planning context, while taking account of the combined effects of all projects, and not of the effects of each project taken separately.
2. It is important to carry out a precise "ex-ante" diagnosis of the economic, social and urban reality which will be affected by the investment, in order to be able to evaluate the effects produced by the projects themselves.
3. Financial evaluations of the impact of projects, which can be calculated relatively easily by cost-benefit analysis, should be separated from evaluations of the social or "environmental" repercussions, which are not expressed in monetary terms.

[64] FRIGOLA Ricardo, SICART Ferran, "Criteris economics per la valoracio dels grans projectes, una approximacio metodologica", Paper for Congress of Public Works; Large-Scale Projects within a European Spinal System, December 1987, 34 p.

Evaluation of the impact of large installations

Duration of study	Mid-1980s
Authors of study	Barcelona centre for Research and Planning and University of Barcelona
Objective of study	• To devise a methodological approach to the effects of large projects planned at Barcelona for the Olympic Games. • To estimate these impacts up to the horizon of 1992.
Methods used	• Application of the Keynesian model to the multiplier effect of investments. • Application of the MOPRE model developed by the Spanish Economic and Finance Ministry.
Indicators observed	• Socio-economic structures of the Barcelona region ; urban structure of the Catalan capital. • Income, labour market, transport costs and flows, accessibility, the land and property markets, industrial sectors. • Amount of investment for each project.
Results	Application of the classical model assumes a multiplier effect of 1.411 for P.I.B., rising to 1.9 with the MOPRE model which integrates subsequent or operational years.
Weak points	• The study does not take account of effects which it is unable to quantify or monetarise. • The evaluation is disconnected from international political and economic contexts and from the planning of European transport networks.

Table O. HEDDEBAUT

2.3.3. Analysis of the effects of rail infrastructures[65]

Planning with regard to railway investment requires an exhaustive knowledge of the existing situation, to avoid exacerbating any possible imbalances between the various constituents of the territory and thereby to contribute to a better homogenisation of the national territory. This is why a study made in the late 1980s and published in 1990 carried out a census of the totality of RENFE's existing facilities and tried to discover coefficients of correlation between the stock of rail infrastructure in a given regional territory, and the level of economic and social development of the different regions of Spain.

The method used consists, on one hand, in classifying the rail infrastructures by type of network (main line, secondary or complementary), and in identifying the length of electrified or non-electrified track for each network, and traffic flows ; it then distributes the infrastructures by province and classifies them by "Autonomous Communities".

On the other hand, it tries to demonstrate correlations between these investments in transport infrastructures and regional data such as land area and population, on the basis of data from the census of 1987, and revenue for each province.

The results show that the degree of regional imbalance - the relation between the entity best endowed with rail infrastructure and the worst endowed - is more significant (deviation greater than 110) at the level of provinces than at that of Autonomous Communities (3.44). The relationship between railway stock and regional imbalance seems to highlight a policy of redistribution and of elimination of imbalances on the part of RENFE, since the richest zones have a relatively smaller stock of rail infrastructure.

However, these observations may be qualified by noting that the structure and dimensions of the railways had not been modified during the fifty years preceding the study, which tends to prove that the incidence of this mode of transport is not especially significant as a condition for regional development. In other words, the relatively better rail endowment of some regions has not improved their relative situation as regards development, while less well-endowed regions have a good level of development.

In addition, this study does not distinguish levels of intensity of use, or of quality of service, of networks from the viewpoint of the user. Finally, the first High Speed Train (AVE) line was not taken into account at that time. This new line, a service provided by Spanish Railways, transcends the provincial or national framework through its very nature and through its potential connections with the European high-speed network, which give it an international dimension.

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65 MEGÍA PUENTE Manuel José, "Distribucion de la infraestructura ferroviaria de RENFE en el territorio peninsular del Estado Español. Analysis en relacion con la superficie, la poblacion y la renta a nivel de Communidades autonomas y provincias", TTC, Journal of the Ministry of Transport, Tourism and Communications, 1990, no. 45, pp. 9-41, and no. 46, pp. 15-42.

Analysis of the Effects of Rail Infrastructures

Duration of study	Late 1980s
Authors of study	Engineer from Department of Civil Engineering
Objective of study	• To make a census of all Spanish railway lines and distribute them by the levels of provinces and Autonomous Communities. • To identify correlations between the rail infrastructure stock of regions and their level of economic development.
Methods used	• Distribution of railway lines into main line, secondary and complementary networks. • Correlation with regionalised socio-economic data.
Indicators observed	Geo-socio-economic structures : land area, population (data from census of 1987) and income (data from Spanish commercial yearbooks of 1989) of Spanish provinces and Autonomous Communities. The composition of the Spanish railway system in main line, secondary and complementary networks in km length of lines and levels of equipment (electrification, grid)
Results	The study shows inverse correlations between rail infrastructure stock and regional level of development. The most developed regions have the least rail stock.
Weak points	• As the study only considers rail infrastructures, it does not trace the effects of transport infrastructures as a whole on a region and its development, nor even, and above all, their effects in combination. • The evaluation is disconnected from international political and economic contexts and from the planning of European transport networks. In particular, it would be interesting to re-run the model while including high-speed infrastructures (Alta Velocidad Española).

Table O. HEDDEBAUT

2.3.4. Effects of major infrastructures on territorial disequilibrium[66]

In Spain since the early 1950s there has been growing territorial disequilibrium which can be observed in the distribution of population over the national territory. Indeed, after a long period of stability when population was split 60% in the interior of the country (regions of Madrid, inner Andalusia, Estremadura and la Mancha), and 40% on the periphery (the other provinces including the maritime provinces), we have seen a reversal of those proportions since the 1950s ; the census of 1975 shows a distribution with 55% on the periphery. Similarly, if population densities are considered, Spain has moved from 50 inhabitants per square kilometre at the periphery as against 22 inh/km^2 in the interior in 1857, to 93 inh/km^2 against 39 inh/km^2 in the 1950s, the figures becoming 130 and 43 respectively in 1975.

These imbalances concern not only population but also the concentration and evolution of production and income. The explanation of this phenomenon is complex, and has its origins in the location of factors of production and in public policies which were or were not applied in the course of Spain's economic development.

This study sets out to demonstrate the influence of major infrastructures on territorial imbalances by comparing, in particular, the transport infrastructure stock of the different regions and by relating this to indicators linked to population which reflect these social and economic imbalances, and to indicators of the accessibility of the road and rail infrastructures, which are generally concentrated in the major urban centres.

The study considers two periods, one, called the pre-industrial period, from 1900 to 1950, and the other, a period of steep economic growth, from 1950 to 1975. The indicators observed for the six great centres of development - Madrid, Barcelona, Valencia, Seville-Cadiz, La Coruña-Vigo and Bilbao-San Sebastian - are population growth and accessibility of complex urban infrastructures on one hand, and proximity to road and rail infrastructures on the other.

The results show a difference between the two periods observed, the deepest imbalances emerging during the second period. In the absence of economic dynamism, population tends to concentrate in the provincial capitals in a migration from the countryside, where living conditions are harsher, to the towns. During a period of sharp economic growth, the polarisation occurs within the large centres of development.

A better provision of complex urban and transport infrastructures favours concentration in certain centres (especially the Basque region and Catalonia), the process being self-reinforcing once it has begun. But if diseconomies of scale occur, industrialisation then spreads to the adjacent provinces. The road network itself seems to have only a slight influence on the production of territorial imbalances.

Finally, the study qualifies its results by introducing factors such as the weight of the history of the provinces, social and cultural traditions which give rise to a stronger or weaker propensity to operate in terms of agrarian self-sufficiency (Andalusia) or to develop exchanges and to show a greater spirit of enterprise in the border regions (Basque region and Catalonia).

It would be interesting to know the results of such a model using current data, reflecting on one hand the new factors resulting from Spain's integration in the European Economic

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[66] OSUNA Jacinto Rodriguez, "Influencia de las grandes infraestructuras sobre los desequilibrios territoriales", Revista Estudios Territoriales, no. 3, 1982, pp. 21-36.

Community in 1986, and its connection to the major European transport networks, and, on the other, its installation of large-scale urban, road and rail facilities in connection with the Universal Exhibition at Seville and the Olympic Games at Barcelona in 1992.

Effects of Major Infrastructures on Territorial Imbalances

Duration of study	Late 1970s
Authors of study	Complutense University of Madrid
Objective of study	• To demonstrate the effects of major infrastructures on territorial imbalances. • To correlate the provision of infrastructures with concentrations of population.
Methods used	• Observation of two periods, 1900-1950 and 1950-1975. • Application of correlation models setting out the different possible relationships between functions : linear, exponential, parabolic and "mixed" parabolic-exponential
Indicators observed	The socio-economic structures of the six great development poles : Madrid, Barcelona, Valencia, Seville-Cadiz, La Coruña-Vigo and Bilbao-San Sebastian. Provisions of complex urban infrastructures and road and rail transport infrastructures of these six poles.
Results	The study shows that the road network in itself seems to have only a slight influence on the production of territorial imbalances. Concentration is heightened in a context of dynamic economic growth.
Weak points	• The results obtained are based on old data which do not reflect the integration of Spain into the European Community. • The evaluation is disconnected from international political and economic contexts and from the planning of European transport networks. This is historically consistent in this case (European context not relevant to Europe before 1970).

Table O. HEDDEBAUT

2.3.5 Evaluation of the fixed link across the Strait of Gibraltar[67]

This study tries to take account of the totality of effects that can flow from implementing a major transport infrastructure, firstly in a theoretical way and then with reference to the project for a fixed link across the Strait of Gibraltar.

The method involves identifying the totality of possible effects and classifying them in four main groups :

1. "Intrinsic" effects corresponding to the reduction in transport costs and time and to the increase in the comfort and reliability of transport.
2. Direct effects induced by construction of the project, which take account of the total production process ; these include the total amount of investment and of intermediate consumption needed for construction, as well as total production regarding expenditure made in the country as a result of wages drawn by firms participating in the investment. This means accounting for the sum of temporary or permanent jobs created by the project in its different stages, as well as markets attributed to it.
3. Indirect or "structural" effects represented by industrial and tertiary developments, tourism, transport and exchange.
4. The effects induced by the indirect effects, which include jobs linked to the expenditure of wage-earners of the firms created or supported by the project ; production linked to investment in industrial or service activities generated by the project, and to intermediate consumption necessary to its implementation ; and production associated with the expenditure of wage-earners of these same firms.

The induced effects are calculated using the Leontiev model, which determines the propagation throughout an economic zone of a growth in final expenditure (final consumption of households and administrations, and the gross formation of fixed capital). This model takes inter-sectoral flows described in the general table of Inputs/Outputs as indicators, while also incorporating internal, external or imported exchanges.

The structural effects are calculated with the same type of econometric model as that used by SETEC Economie for road infrastructures, based on time savings and observation of traffic. It is adapted to the Gibraltar fixed link by considering two variants : either a bridge or a tunnel. The zone of economic influence identified is formed in Spain by the regions of Cadiz, Malaga and Seville, and in Morocco by the regions of Tangier, Tetouan and Chaouen ; the reference year for the socio-economic data is 1989.

In its second stage, the study carries out projections up to 2000 and 2020 for each of the variants, bridge or tunnel, in order to determine the impact of a fixed link on economic activity and employment in the zones influenced, in both Morocco and Spain. The results show that the bridge variant would create more jobs (26 100 up to 2000 and 52 300 up to 2020) than the tunnel variant (23 000 in 2000 and 45 500 in 2020). Regarding traffic, the study ascertains that, for goods traffic, there would be an increase of between 14% and 18% of the total base traffic for the bridge project, and of between 12% and 14% for the tunnel project, as a result of the higher hypothetical base traffic for the tunnel. As regards passenger

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[67] SNED/SECEG, SETEC Economie, Maroc Structures, "Etude de faisabilité économique de la liaison fixe Europe-Afrique à travers le détroit de Gibraltar", Report no. 8, Impact de liaison Fixe, January 1990, multiple numbering + annexes.

traffic, the results show an increase for both variants envisaged (higher for the bridge variant) ; this relates to tourist traffic but especially to an increase in traffic linked to relocation of jobs.

Evaluation of the Effects of the Fixed Link across the Strait of Gibraltar

Duration of study	Late 1980s
Authors of study	Consortium of private consultancy firms : SETEC-Economie, , Maroc Structures and EYSER working for the two state companies SECEG for Spain and SNED for Moroco.
Objective of study	• To implement a methodological approach to the effects of major projects, as applied to the projected fixed link across the Strait of Gibraltar • To estimate these impacts for the horizon years 2000 and 2020 for the variants bridge or tunnel.
Methods used	• Application of the Keynesian model regarding the multiplier effect of investment. • Application of the SETEC-Economie model.
Indicators observed	Socio-economic structures of the zones influenced in Morocco and Spain. Revenues, labour market, transport costs and flows, industrial sectors. Amount of investment for each project.
Results	The study shows that regardless of which variant, bridge or tunnel, is chosen, the regions of influence studied will experience a growth in employment, while passenger and goods traffic will also increase by more than 10%.
Weak points	• The results obtained are based on the principle of the "automatic" diffusion of investment throughout regional industry, and on the given structure of employment. • The study limits the effects to economic zones close to the outlets of the fixed link. • The evaluation is disconnected from international political and economic contexts and from the planning of European transport networks.

Table O. HEDDEBAUT

2.4. Case studies and methods used in Switzerland[68]

2.4.1. Study of the effects of the Geneva-Lausanne motorway[69]

The aim of this study, carried out twelve years after the opening of the motorway, is to identify the effects of the motorway on the internal structure of the region (measurement of intra-regional effects), by highlighting the mechanisms which have contributed to spatial structuring. In other words, the development of regions directly served by the motorway is compared with that of areas which are not. It also investigates the effects on conurbations compared with the effects on rural areas, as well as the impact on urban as opposed to regional centres. The study does not therefore deal with the motorway as an instrument of regional development, and no research has been done into whether the region experienced more rapid growth as a result of this investment.

This study uses an inductive method which seeks to detect mechanisms, on the basis of observation of empirical data, by comparing the situation before and after completion of the work. In view of the importance of non-road factors on the development of the region, the authors have preferred to place the emphasis on highlighting spatial structuring mechanisms rather than on seeking statistical links. A more global approach has been preferred over the sectoral, essentially economic approach, which is generally used in this type of study. The effects on both the transport system and spatial structures are revealed. The report also contains an evaluation of relevant literature in Switzerland and abroad.

The conclusions deal with the internal structure of the region and not with its development in relation to other parts of the country. Because of its tangential design, the motorway has promoted the development of the two major conurbations located at both ends and thus reinforced the hierarchy of the centres. Few effects have been observed in the immediate vicinity of the junctions, which may be explained by the fact that the latter are very close together. The effects tend to be felt over a wider radius. The construction of a motorway is not just a technical problem ; the motorway has a wide variety of financial, economic, social and environmental repercussions.

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68 JEANRENAUD C., "Panorama des principaux projets d'analyse des effets structurants des transports en Suisse", Communication au Comité de gestion de COST 317, Bruxelles, janvier 1992, 15 p.

69 C.E.A.T., "Etude des effets de l'autoroute Genève - Lausanne douze ans après sa mise en service", Publication No 2, Lausanne, 1978.

Study of the effects of the Geneva-Lausanne motorway

Period of the study	12 years after opening of motorway
Authors of the study	C.E.A.T.
Objective of the study	To identify the effects of the motorway on the internal structure of the region.
Methods used	- Inductive method : comparison of the situation before and after ; - Global approach : effects on transport system and spatial structures ; - Bibliographical analysis.
Indicators observed	Accessibility, influence of urban centres in relation to regional centres, spatial structuring mechanisms.
Results	Development of urban centres located at both ends ; Reinforced hierarchy of centres ; Few effects at junctions.
Weak points	

Table O. HEDDEBAUT

2.4.2. Study of the effects of the Yverdon-Avenches section of the N1 motorway[70]

The aim of this study is to evaluate the effects of the construction of the N1 motorway on the development of the region between Avenches and Yverdon.

The authors first of all evaluate the region's development prospects using a "no-change" hypothesis. For this, they use a model describing the workings of the labour market (Fischer model), regarded as the decisive factor in the development of a region. The imbalance between supply and demand in the workforce is obtained by simple extrapolation.

In evaluating the impact of the new road, the primary effects are identified first, i.e. the jobs and revenue generated by construction and operation of the motorway, plus some of the transportation advantages. Then the secondary effects are looked at, which are the effects relating to capacity and fiscal return. Finally, there are the external effects : the price of land, polarization and sources of nuisance.

The types of effect are not defined and delimited in a very precise way. No distinction is drawn between the real costs and benefits of the project and those which have a purely redistributive character. The weight which the authors attach to different variables is not stated. A number of variables of the model are difficult if not impossible to quantify.

70 KASPAR C., BOOS E., "Les effets économiques régionaux concernant la construction ou non de la route nationale N°1 entre Yverdon et Avenches", Commission chargée du réexamen de tronçons de routes nationales, mandat No 16, St-Gall, 1980.

Essentially, a list is given of factors influenced by the project which determine the development of a region.

The study concludes, however, that the new link will make for the creation of a number of jobs, without stating whether they are long-term or short-term, or whether this is real job creation or simply redistribution between regions. But the motorway will have little impact on the development of the region it crosses.

Study of the effects of the Yverdon-Avenches section of the N1 motorway

Period of the study	End of the 1970s
Authors of the study	Swiss motorway review board
Objective of study	To identify the effects of the motorway on the development of the region between Yverdon and Avenches.
Methods used	- Evaluation of the region's prospects without a motorway ; - Application of the Fischer model to the labour market ; - Extrapolation of supply and demand in the workforce.
Indicators observed	Primary effects : jobs and direct revenue arising from construction and operation of the motorway ; Secondary effects : capacity, fiscal return ; External effects : land prices, polarization, nuisance.
Results	Creation of a number of jobs ; Little impact on the region crossed.
Weak points	No distinction between "generated" and "redistributive" effects ; Variables impossible to quantify, or weight not explained.

Table O. HEDDEBAUT

2.4.3. Study of the N8 motorway across the Grand Marais[71]

This study evaluates the effects on the economic development of the regions served by the construction of the new N8 motorway between Brienzwiler and Ewil, which crosses the Grand Marais and links up with the N1 and the N5.

The starting point of the analysis is an in-depth examination of traffic flows : regional traffic, within the Grand Marais, and inter-regional traffic with the reference region split up into six main areas. Various hypotheses are put forward in relation to completion of the motorway network (N1 and N5).

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71 GAUDARD G., DEVAUD F., GUIDICETTI N. et SPICHER B., "Die regionalwirtschaftlichen Auswirkungen der N8 (Brienzwiler-Ewil)", Centre de recherches en économie de l'espace de l'Université de Fribourg, Fribourg, 1985.

In order to evaluate the induced changes in traffic (transferred, converted and generated) and to compare the variants, savings in time and cost have been estimated via isochrones, isovectors and isocosts.

The regional impact of the new link is estimated, using the CRESUF model, on the basis of four types of effect : initial, induced, external and psychological. A qualitative evaluation of the effects is made for the primary, industrial and services sectors of the three cantons directly affected and for the Grand Marais region.

The conclusions show that the most substantial effects are expected to be felt by the canton of Neuchâtel. They reveal an improvement in the attractiveness of the region for industrial activities, a widening of the labour catchment area and greater competition in the services sector.

There is some uncertainty as regards the effects on the Grand Marais region. The development effects will probably be negligible. The most important expected benefit for this region is an improvement in the quality of life of the inhabitants of the villages through which the existing road passes.

Study of the N8 motorway across the Grand Marais

Period of the study	Early 1980s ?
Authors of the study	CRESUF : Centre de Recherche en Economie Spatiale de l'Université de Fribourg
Objective of the study	To identify the effects of the motorway on the economic development of the regions it serves.
Methods used	- Analysis of regional and inter-regional traffic flows ; - Use of CRESUF model ; - Execution of isochrones, isovectors and isocosts.
Indicators observed	Initial and induced effects on primary, industrial and services sectors ; External and psychological effects.
Results	Major impact expected for the Neuchâtel region ; Little impact on the development of the Grand Marais region, but improved quality of life owing to diversion of traffic.
Weak points	

Table O. HEDDEBAUT

2.4.4. *Evaluation of the T20 Neuchâtel-La Chaux-de-Fonds link*[72], [73]

This study forms part of the assessment of the new T20 Neuchâtel-La Chaux-de-Fonds link. The aim is to show the relationship between road links and the economic development of a region. It is a general analysis with a specific application to the T20 motorway.

These studies review existing literature on the effects of infrastructures and give the isochronous curve calculations. Then the typological method of cost-benefit analysis is the main one used.

For users of the motorway, there are gains in time, safety and comfort. The most beneficial aspect is concerned with savings in transport costs for firms according to whether these are connected with the motorway network or not. It is noticeable that companies with direct access to the motorway network make substantial savings on fixed transport costs, which means that they can work with a smaller vehicle fleet. Secondly, there is the analysis of the "regional impact of transport benefits". This identifies the recipients of transport benefits and the types of region in which they are based. A traffic survey was carried out at the Col de la Vue des Alpes which established five categories of users according to the reason for travel and the type of vehicle. It reveals that a large proportion of the benefits accrue to the Neuchâtel region of the Jura.

Evaluation of the T20 Neuchâtel-La Chaux-de-Fonds link

Period of the study	1982
Authors of the study	Groupe d'Etudes Economiques de l'Université de Neuchâtel
Objective of the study	To demonstrate the relationship between road links and the economic development of a region, and application to the T20 Neuchâtel-La Chaux-de-Fonds motorway link.
Methods used	- Cost-benefit analysis (economic efficiency of the project) ; - Regional impact analysis (regional distribution of revenues) ; - Traffic survey (qualitative study of flows).
Indicators observed	- Internal viability of project, accessibility ; - Regional structures, distribution of revenues ; - Transport demand, origin/destination, reason for travel, vehicle type.
Results	Major impact expected for the Neuchâtel region of the Jura.
Weak points	

Table O. HEDDEBAUT

72 JEANRENAUD C. et SCHÖPFER A., "Liaison Neuchâtel - La Chaux -de Fonds et tunnel sous la Vue-des-Alpes", Etudes socio-économiques, vol. 1 et 2, Groupe d'études économiques, Université de Neuchâtel, Neuchâtel, 1982.
JEANRENAUD C., "Incidence régionale et évaluation d'un projet routier : Le cas de la nouvelle liaison T20 Neuchâtel - La Chaux de Fonds", in Gaston Gaudard, Les transports et la région, Editions Universitaires, Fribourg, 1984, pp 199 - 141.

73 MAILLAT D., BEGUIN F., BOULIANNE J.-M., DELALEU D. et GOLAY J.-F., "Axes routiers et développement économique", vol. 1 et 2, Groupe d'études économiques, Université de Neuchâtel, Neuchâtel, 1982.

The results highlight the importance of being connected with the motorway network. It is essential, however, that transport policy be integrated with a development strategy, the road axis being no more than a "powerful lever" in a development programme.

2.4.5. Evaluation of the effects of the RN 12 motorway on the Bulle region[74]

This study aims to estimate the contribution of a new motorway link to the development of a micro-region, the region of Gruyère and the town of Bulle, several months after its opening. It attempts to evaluate the effects anticipated by the region's economic operators. It uses the method of in-depth discussions with representatives of the economy and the authorities of the region. It makes use of statistical analysis to show changes in the behaviour of the region's economic operators. The study highlights anticipated effects, shows the importance of back-up policies and stresses the importance of psychological effects : the belief that a motorway contributes to economic development.

Evaluation of the effects of the RN 12 motorway on the Bulle region

Period of the study	1981-1982
Authors of the study	Communauté d'Etudes pour l'Aménagement du Territoire à Lausanne
Objective of the study	To demonstrate the relationship between road links and the economic development of a micro-region.
Methods used	- Statistical analysis ; - In-depth discussions with the region's economic operators and political authorities.
Indicators observed	- Regional economic and social structures ; - Industrial sites, Bulle property market, tourism in Gruyère region.
Results	Major impact expected for the Gruyère region ; Emergence of political consensus for promotion of region ; Motorway is one parameter in the siting of companies but never the decisive factor.
Weak points	Very short time between opening of Lausanne-Bulle-Fribourg motorway (autumn 1981) and observation period (end 1981-1982).

Table O. HEDDEBAUT

[74] THEVOZ L., "L'autoroute comme facteur de développement économique: le cas de Bulle", in Gaston GAUDARD, les transports et la région, Editions Universitaires, Fribourg, 1984, pp. 213-233.

2.4.6. Study of a rail link : the Val Bedretto case[75]

This study contains an "ex ante" evaluation of the impact of a rail link with a station for the transfer of cars on the development of a small Alpine valley. The project would enable the whole canton of Ticino to be connected throughout the year with the Valais and Western Switzerland.

It uses an "effects analysis method", which investigates the changes in socio-economic structure and the links between the transport infrastructure and its regional and supra-regional context. The author distinguishes between effects produced at the time of construction and effects expected after the system has become operational. It also considers external and psychological effects.

The study notes that substantial effects on the development of the regions served cannot be expected in the case of this project. In fact, accessibility would improve only for the winter and the region is ill-equipped to take advantage of the new situation. In the summer, the tourist season for Val Bedretto, faster access can be gained by road.

Study of a rail link : the Val Bedretto case

Period of the study	1982-1983 ?
Authors of the study	CRESUF : Centre de Recherche en Economie Spatiale de l'Université de Fribourg
Objective of the study	To identify the effects of a rail system on a small valley.
Methods used	- Impact study ; - Analysis of structuring effects.
Indicators observed	Primary effects : jobs and direct revenue arising from construction and operation of the rail system, in relation to the three economic sectors ; Accessibility of the valley ; External effects : negative impact on landscape ; Psychological effects.
Results	Little impact on the development of the regions served.
Weak points	

Table O. HEDDEBAUT

75 De GOTTARDI R, "Une stratégie de désenclavement dans un système de liaisons ferroviaires: le cas du Val Bedretto", in Gaston Gaudard, Les transports et la région, Editions Universitaires, Fribourg, 1984, pp 143-158.

2.4.7. Evaluation of a new transalpine rail link[76]

This study aims to perform a critical analysis of the methods used by Motor Columbus and Infras to estimate the regional effects of a new transalpine rail link (NLFA).

The consultants make use of the scenario method, defining three scenarios for Switzerland in the context of this project. The first, "scenario H", forecasts economic growth for Switzerland and modal distribution of traffic to the railways, the second, "scenario L", envisages the opposite situation, and the third imagines the removal of restrictions applied to road freight transport in Switzerland and Austria.

The study seeks to demonstrate that use can be made of an "analysis of potential", i.e. of changes due to accessibility, to evaluate the regional effects of a new transalpine link. It ends up with a classification of the regions under consideration.

The work of the University of Zürich on this study of the NLFA's impact has come up with a number of points and recommendations :

- it would appear sensible to perform an "analysis of potential", but it is essential to integrate such analysis into a regional development model ;
- can the effects of the NLFA be forecast without looking at the function of poles of activity in Switzerland and the roles they play in the system of European cities ? ;
- dealing with distributive effects in terms of "redistribution" (modification) of accessibility is a problematic process ;
- an improved link between regions tends to increase competition. An analysis of competitiveness is therefore necessary to identify the regions most likely to benefit from the new link ;
- use of the resident population as an indicator of potential is open to criticism. An analysis of potential covering sub-groups of the population relating to workplaces and economic sectors, or jobs in terms of qualifications, would certainly have resulted in more significant findings ;
- use of the resistance function (quadratic exponential function) is not the most desirable choice. This certainly constitutes the most questionable aspect of the process since this choice in itself virtually determines the outcome of the analysis. It would be desirable to choose coefficients in such a way that this function decreases slowly and to establish psychological thresholds such as a journey of under three hours, half a day, a whole day, time taken by the competing mode of transport, etc. ;
- account should be taken of the local, national, international and political context and of the strategy of the operators who will use the new infrastructure ;
- finally, it is essential to look at how the new infrastructure fits in with the planning of European transport networks, thereby enabling Swiss national networks to be integrated.

[76] MAGGI R., "L'évaluation des impacts régionaux d'une nouvelle transversale ferroviaire à travers les Alpes," Séminaire sur les effets du Tunnel sous la Manche sur la structure des flux de trafic des 27 et 28 novembre 1989, COST 312. Bruxelles, 1990, pp. 35-38.

Evaluation of a new transalpine rail link

Period of the study	1986-1987
Authors of the study	Motor Columbus INFRAS University of Zurich (critique of the study evaluation methods of Motor Columbus INFRAS)
Objective of the study	To find a solution for European transit traffic ; To identify the effects of a new transalpine rail link on economic and regional development in Switzerland.
Methods used	- Study of 5 variants of the NLFA ; - Scenarios method ; - Analysis of potential.
Indicators observed	Transport demand, internal viability of projects, accessibility, regional structures, industry, capital goods, services and tourism sectors ; Impact on employment and regional revenue during construction ; External effects on the environment.
Results	Major impact expected for the Neuchâtel region ; Classification of regions involved, no significant impact on development of Grand Marais region, but improved quality of life due to diversion of traffic flows.
Weak points	Tools, methods and concepts are questionable. Unconnected evaluation of local, national, international and political contexts, of operators' strategies, and of the planning of European transport networks.

Table O. HEDDEBAUT

Looking at all the Swiss case studies, we can conclude by quoting Gaston Gaudard[77], who maintains that "any fresh initiative in the field of transport effectively means a change in the regional environment. Conversely, the quality of the regional environment can itself favour a change in transport infrastructures. This close interdependence means that to have a clear understanding of the potentialities of transport, it is also necessary to have a clear grasp of the nature of the regional environment". Finally, these different analyses show that it is unrealistic to seek to evaluate the effects of a transport infrastructure link without setting it against the whole national or even international network of the same kind, or without taking into consideration any back-up policies implemented to try to maximize the positive spin-off of the project. This is perhaps a result of the method of funding studies and evaluations. In fact, analyses of the effects of infrastructures usually do not go beyond the administrative limits - those of the canton, in most cases - of the authorities funding the studies.

77 G. Gaudard, "Les transports et la région", Synthèse in "Les transports et la région", Editions Universitaires, Fribourg, 1984, pp.235-244.

2.5. Case studies and methods used in the Netherlands[78]

There are no official or recommended methods in the Netherlands for evaluating transport infrastructure projects or estimating investment in infrastructures. However, COBA, the commission for developing policy analysis techniques, has recommended cost-benefit analyses as a suitable tool for project evaluation.

In particular cases, other techniques such as multi-criteria analysis, sectoral studies or regional impact analysis are also used by the Ministry of Transport as decision-making aids.

The procedures and methods used in the Netherlands to perform evaluations may be illustrated with reference to specific case studies. These have been chosen to show the results of research and problems encountered by researchers in the course of the evaluations.

2.5.1. Study of the Zuiderzee rail link

This study was undertaken between 1982 and 1988 to find out the economic and social consequences for the national and regional economy if the Zuiderzee rail link was built and put into service. The planned rail link would connect the cities of Lelystad and Groningen in the north of the country. Results of the feasibility study were published in mid-1985 and the final report in 1988. The study examined the results of economic and financial forecasts and compared variants of a scenario for the year 2000 with the situation which would arise if nothing was done. The estimated journey demand was based on a "long-distance journey model", a transport model which was developed by a consultant specifically for this project.

Particular attention was focused on the following points :

- increased accessibility for the north of the Randstad ;
- financial consequences ;
- benefits to passengers ;
- external effects (such as impact on the natural and urban environments, noise, etc.) ;
- road safety ;
- economic development of the North. (This research was undertaken by the Geographical Institute of the University of Groningen).

To present the results of this evaluation, the effects and results have been displayed in tabular form but have not been weighted to give an overall score.

The main findings are as follows :

- Transport models are useful instruments for estimating the probable increase in rail journeys arising directly from the reduction in journey time. In particular, this should benefit those who would use the new line to get to work or for business travel. (However, researchers suggest that such models are liable to underestimate the total long-term journey demand. It is difficult to estimate the full extent of latent demand, especially for trips connected with leisure and social activities. In addition, a static model has little chance of giving a precise representation of reality if the transport infrastructure is intended to lead eventually to structural change, for example, in the location of homes, offices and factories).
- The positive aspect would lie in work-related passenger traffic and, to a lesser extent, goods traffic connected with exports and imports in the industrial and services sectors. Completion of the Zuiderzee line may not have an impact for a specific company, but as

[78] CHEUNG F., "Effects of infrastructure, case studies and methods used in the Netherland, juillet 1993, 5 p.

firms did not use any rail structure previously, there is little reason to expect direct benefits from this infrastructure for the future.

- A wide-ranging survey by telephone, followed by in-depth consultation with firms located close to the stations planned for the project, shows that people are generally well-informed about the scheme. Estate agents and bankers are very optimistic, with high hopes of direct economic benefits on their activities.
- The scope of the indirect effects depends on how much importance the new Zuiderzee project will attach to improving the image of the North in general and the areas in the immediate vicinity of the new line in particular.

The Zuiderzee rail link

Period of study	1982 - 1988
Authors of study	Consultant Geographical Institute of the University of Groningen (one part)
Objective of study	To study the economic and social consequences of the Zuiderzee rail link on the national economy and that of the Northern Netherlands
Methods used	• Scenarios up to 2000 compared with no-action variants • Estimation of demand using "Long-distance journey model" • Telephone survey • In-depth discussions
Indicators observed	Accessibility, financial results, land and property markets, safety, economic situation in the North, external effects
Results	Benefits for trips between home and work ; Financial benefits and rise in land values expected ; Likely improvement in image of Northern provinces
Weak points	Not taken into account in the static model of structural and/or territorial changes generated by the infrastructure

Tableau O. HEDDEBAUT

2.5.2. The Paris-Brussels-Amsterdam high-speed rail (HSL) link

A key economic argument for the construction of a new high-speed rail link is that it would provide a high-quality infrastructure which would generate significant reductions in journey times. In addition, this investment would improve the attractiveness of the Randstad as a location for the head offices or branches of international business concerns. The evaluation examines the project's economic viability and overall economic effects for the Netherlands.

In an "ex-ante" evaluation, demand forecasts based on the "long-distance journey model" using a basic variant of the "no-change" situation are compared with other variants going up to 2003. This business economic study was carried out by a research team from three consultants, McKinsey-MVA-OC&C. The aim of the study was to determine the financial viability. It was funded by the Ministry of Transport and the team reported in 1993.

To study the general economic impacts of a Netherlands connection with the European network of high speed rail (HSL), a new study (also funded by the Netherlands Ministry of Transport) was carried out by a consortium of three Dutch consultants: Buck Consultants International, Bureau voor Economische Argumentatie and Netherlands Economic Institute. The study began in October 1992 and completed in February 1994.[79]

Three sources of information were used in the investigation:

1. A bibliographical study of literature over the economic effects of HSL, based primarily on French and German reports.
2. A fact-finding trip by Dutch consultants to France to interview representatives of SNCF, officials from Regional Councils and Regional Development Agencies, research bodies and specialists in transport economics and regional development.
3. A forecasting exercise using quantitative methods and modelling.

The study concentrated on the effects of international passenger traffic along the Amsterdam-Brussels-Paris/London axis with particular attention on the extent to which accrued socio-economic effects would benefit the Dutch economy. The study made a clear distinction between "generated" and "redistributive" effects, and between effects on the Netherlands and those with an impact reaching beyond national boundaries. Effects arising from the construction and maintenance activities of the HSL are excluded.

General economic effects can be classified as direct and indirect effects.

Direct effects are:

- time savings and reductions in travel costs for existing traffic
- time savings and reductions in travel costs for newly generated trafficefficiency gains for business journeys, in particular the possibility of using journey time more productively than alternative means of travel
- increased possibilities for single-day return journeys and savings associated with such trips.

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[79] BCI, BEA, NEI "Economische Effecten Hoge-snelheidslijn, Eindrapportage", February 1994 .

ZELLE R., KLOOSTER J. "Economic Impact Study of High Speed Train Amsterdam-Paris/London" Paper presented to the U.S. Transportation Research Board Annual Meeting January, 1994."

Indirect effects are:

- growth in imports and exports related to an increase in business trips.
- additional employment generated by an increase in total expenditures by existing business and new offices in the Randstad region (agglomeration comprising the areas surrounding Amsterdam/Rotterdam/Utrecht).

These effects are complemented with the argument that the Netherlands connection with the European HSL network is likely to have a positive influence on the business location climate and could raise the relative international competitiveness of the Randstad region. The proposition is based on the following arguments:

- the HSL improves accessibility and attractiveness of the areas it serves; as such, it may have a positive influence on the location decision for business and industries at home and from abroad.
- the HSL also has an "image effect": the availaibility of high quality service means that even when the HSL is not actually used intensively or regularly, it still has a 'back up' function as an attractive alternative to long distance travel by car, aeroplane or conventional train.
- the actual and potential values of high speed connection (in conjunction with other favourable location factors) can enhance the competitive power, thus retenting existing business and attracting new enterprises to establish in the Randstad region served by the HSL.

The study report recognized that the HSL, on its own, would not be able to induce substantial economic growth. However, the study team stated that the HSL, when reinforeced with other supporting measures, would strengthen the chance of creating a favourable business location climate and influence spatial development. The thesis is based on the "dynamic interplay" of the relative positions of regions which compete with one another. A region served by high quality infrastructure such as connection to the European HSL network is likely to be more competitive than areas not served by such investment. Following this line of argument, the study concluded that the Randstad region would be the main beneficiary. Back office activities and European head offices would be particularly attracted by the HSL connection. Moreover, the HSL could serve a supporting role to achieve the stated policy objective to develop Schiphol as a mainport. Substitution of journeys on European flights by the HSL will increase the capacity of Schiphol airport for international flights.

The Paris-Brussels-Amsterdam high-speed train (TGV) link

Period of study	1st	1991-1993
	2nd	1992 - 1994
Authors of study	1st	Consultant under auspices of Transport Ministry
	2nd	Consortium of three Dutch consultants
Objective of study	1st	To determine financial viability of infrastructure investment.
	2nd	To study the general direct and indirect economic impacts on the Netherlands economy.
Methods used	1st	- Scenarios to 2003 compared with "no-change" variant ; - "ex-ante" evaluation and estimation of demand using the "long-distance journey" model ;
	2nd	- Bibliographical study ; - fact-finding trip, discussions with experts ; - model exercise
Indicators observed	1st	?
	2nd	Accessibility, financial results, productivity, traffic ; land and property markets, jobs, imports and exports
Results	1st	The HSL is likely to have a positive influence on the business location climate and could raise the relative international competitiveness of the Randstad region.
	2nd	The HSL could serve the development of Schiphol airport.

Table O. HEDDEBAUT

2.5.3. The Amsterdam orbital motorway[80]

The Amsterdam orbital motorway was built to link residential areas north of the River Ij with industrial areas which have moved from the city centre to the south of the Amsterdam conurbation. This was a major project by Dutch national standards and construction of the motorway was expected to have a significant effect on the urban development of the surrounding areas. The motorway was built in several stages, making use of some already existing sections, and was completed in September 1990.

80 BRUINSMA F., PEPPING G., RIETVELD P., " Infrastructure and urban development; the case of Amsterdam orbital motorway ", Vrije Universiteit Amsterdam, April 1993, 23p.

In addition to analysis of the impact produced by the opening of the orbital motorway on time-saving and growth in journey demand, research was undertaken by the Economics Department of Amsterdam University, based on various approaches :

- Discussions with experts in the field of office location in the Amsterdam region, i.e. estate agents, officials of public bodies and heads of companies in the vicinity of the orbital motorway. The results are generally positive, and the points of view expressed range from a better perception of the market on the part of potential investors to a better image in the eyes of existing firms situated near the motorway, plus improved accessibility of sites close to the motorway.
- A study was also performed to find out variations in land values and property rents, in particular for offices, as businesses had expressed interest in purchasing land which was more readily accessible. Whereas the construction of new offices would have taken a considerable time, improved accessibility could be reflected immediately in rental prices. Impact and regression analyses using as data the prices for transactions involving offices of over 500 m^2 on the Amsterdam property market for the 1987-89 period (before completion of the work) and for 1991 (just after the motorway became fully operational) show that the motorway may be regarded as an important factor in choosing office locations. A statistical analysis of office rents reveals that the distance to the nearest motorway junction has a significant negative impact on the price of offices. The effects are not as great as regards easy access to rail or underground stations.
- 516 questionnaires were also sent to heads of firms with more than ten staff in June 1992. The firms were divided into three categories, according to their distance from the motorway and whether they had moved before or after it had opened. Respondents to the survey were chosen from four sectors of the economy : industry, distribution, services and property.

A large proportion of them (75% or more) use the orbital motorway frequently. This infrastructure is regarded as important for transport-related activities such as incoming and outgoing movements of goods, client visits and travel between home and work. The services sector is the sector which makes the least use of the motorway in the area furthest away.

Two-thirds of businessmen who were asked what was the biggest obstacle to their firms' activities before the motorway opened complained about congestion. The opening of the motorway has meant better traffic flows, and many companies have recorded an increase in turnover, a fall in production costs and/or improved punctuality in deliveries.

Even if it is difficult to distinguish the real from the psychological effects, the fact remains that 10% of firms would have restricted their investments if the motorway had not existed.

The Amsterdam orbital motorway

Period of study		
	2nd	1987 to 1989 and 1991, and June 1992
Authors of study		
	2nd	Economics Department of Amsterdam University
Objective of study	1st	To analyse the impact of the opening of the motorway
	2nd	To study the effects on the siting of offices and industrial plants
Methods used		
	2nd	- Discussions with experts ; impact and regression analysis with regard to distance from motorway junctions, railway and underground stations. - Survey using questionnaires.
Indicators observed		
	2nd	Accessibility, reasons for increased demand. Transaction prices in land and property markets ; 516 firms with more than 10 staff.
Results		
	2nd	- better image of market for investors and firms already in area ; - motorway an important factor for offices close to junctions ; - influence on office rents, which are greatly affected by proximity of motorway junction, less so by railway or underground station ; - for companies, savings in time and operating costs, greater productivity, turnover and investment.

Table O. HEDDEBAUT

2.6. Case studies and methods used in Denmark[81]

The Danes are trying to develop a new way of evaluating the effects of major transport infrastructures by means of models integrating features of the regional economic structure in which they are programmed. This is a different approach from traditional traffic models which aim to forecast demand with the help of aggregated statistical models.

The fundamental idea behind this new approach is that the transport infrastructure plays a major role in economic change but transport investment requirements basically arise from the structure of local economic development. Investment in transport infrastructures is a response to economic changes but at the same time it is an agent of such change, creating fresh movement of persons and goods, services and information, which in turn generate economic change. Hence, to evaluate the effects of these infrastructures, it is first of all necessary to understand how the regional economies work.

This approach therefore aims to establish the relationship between the transport infrastructure and changes in essential economic variables such as employment, cost and production functions. Traffic flows are therefore analysed for their impact on employment and revenue in the region under observation.

2.6.1. Study of the economic effects of the "Great Belt" link[82]

This study has two objectives. The first is to provide a theoretical and methodological framework for analysing the effects of major transport infrastructure projects, based on regional macro-economic models. The second is to present the initial results of the model applied to a specific project, namely the Great Belt link, taking account of related improvements to the transport system.

Denmark consists of a series of islands with a population of about five million. Copenhagen, which accounts for 1.7 million inhabitants including the suburbs, is situated on the island of Zealand, separated from the rest of Denmark by an 18 kilometre-wide channel, the Great Belt. At the end of 1988, Parliament approved the construction of a fixed link between Zealand and the island of Fyn, itself connected by two bridges to the main peninsula of Jutland. In addition, this decision was backed up by the agreement signed between Sweden and Denmark in 1991 concerning the construction of a fixed link between their two countries across the Øresund strait, presupposing the prior completion of the Great Belt link. The expected opening date for the rail link (bridge and tunnel) is 1994, and for the road link (bridge) 1997.

First of all, this study surveys the different ways of evaluating the effects of a major transport infrastructure, and outlines the methodological process applied to evaluation of the impact of such a link.

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81 JENSEN-BUTLER C., MADSEN B., "Regional consequences of transport infrastructure investment : Three bridges in the western baltic", presented at the NSRSA Conference held at Kiel, october 1992, 11 p. + Cartes.

82 B. Madsen, C. Jensen-Butler, "The regional economic effects of the Danish Great Belt link and related traffic system improvements", Communication to COST 317 Management Committee, Brussels, 15 January 1993, 31 p.

Up to 1985, the impact of the link is based on traffic forecasts, covering three categories :

- a general increase in traffic due to economic growth ;
- traffic diverted from other modes or routes ;
- additional traffic induced by the infrastructure.

The level of induced traffic is the subject of much debate and is continually revised upwards until 1988. No mention is made of the way in which the regional economy can generate traffic and how traffic can influence the regional economic structure.

From 1985 onwards, a number of studies look at the regional economic structure and changes in the transport system, but it is from a static approach without reverse effects on the economic structure itself. Effects are divided into three phases :

- initial effects connected with the construction period in which the cumulative effects of large-scale investment on the economy can be felt ;
- short- and medium-term effects of the opening of the link on the region's revenue, employment and production, including changes in inter-regional trade ;
- long-term dynamic effects of the opening of the link on the siting of production plants, industrial organization, logistics, etc.

These studies conclude that the regional economic effects will be very limited as there is little trade between eastern and western Denmark and transport costs average a mere 7% of the price of goods.

New studies compare modifications in import and export structures induced by new transport costs, using a price elasticity model, with structural changes in the regional economies via production and employment. They conclude the impact will be low or even positive for the regions of Fyn and South Jutland, and negative for the region of North Jutland.

In 1990, the studies focus on the long-term effects of the opening of the link. One of them investigates in particular the computer services sector. It does not use a regional model but contains a qualitative empirical analysis based on a series of questionnaires. It shows that effects will be minimal as regards goods traffic, but companies located at both ends of the link, on Fyn or in Vestsjælland, will benefit in terms of business traffic. One conclusion of the study is that transport costs are not the only factors in determining the siting of firms, especially for the computing sector which is already firmly established in the Copenhagen region.

The study then seeks to identify the effects of the Great Belt link, applying AIDA, a regional and inter-regional economic model developed in Denmark.

Denmark is divided into twelve regions,[83] six sectors of production,[84] and seven types of final demand[85]. The functioning of the Danish regional economy is analysed in terms of supply and demand in goods and services by sector and region. Analysis of inter-regional import and export flows provides a clear insight into the spatial economy.

[83] 1 Greater Copenhagen, 2 Vestsjælland, 3 Storstrøm, 4 Bornholm, 5 Fyn, 6 Sønderjylland, 7 Ribe, 8 Vejle, 9 Ringkøbing, 10 Arhus, 11 Viborg, 12 Nordjylland.

[84] 1 Agriculture, 2 Industry, 3 Construction, 4 Private services, 5 Transport, 6 Public services.

[85] 1 Private consumption, 2 Public consumption, 3 Equipment investment, 4 Property investments, 5 Movable investments, 6 Exports, 7 Financial services.

The study then envisages the consequences of alterations to transport costs arising from infrastructure improvements for all regions, in three stages :

- redistribution of existing imports and exports as a result of cost differentials ;
- an increase in export flows for regions where production costs should fall owing to improved accessibility ;
- an increase in international exports and fall in international imports induced by cost differences.

Only the first two stages have been covered by the study. The third is to be covered by later studies, taking account of the other Danish links with Germany and Sweden.

Generalized costs for goods transport[86] are calculated in this model for the situation existing before the opening of the Great Belt link, on the hypothesis that goods are routed according to the principle of the cheapest journey. This procedure is then repeated for the opening of the Great Belt link and the associated improvement of the transport system (motorways), on the hypothesis of two ferry links being maintained[87].

Results show that gains are marginal, with time saved only for journeys actually crossing the Great Belt and benefits only for the regions located at the ends of the link.

Generalized costs for passenger transport[88] are calculated in this model for the situation existing before and after the opening of the link, also taking account of the improvement to the transport system (motorways and high-speed trains), with two ferry links being maintained. The model is greatly simplified as it only takes account of costs connected with time. It also constructs the hypothesis of a systematic transfer from car to train in cases of time saved. The results show an increase in transport costs.

Changes in the structure of flows are calculated in the same way. To present the results, the model groups together the twelve regions of Denmark into three major zones[89] and presents the situation existing before the opening of the link : for agriculture, export flows are from zone 2 to zone 1 ; for industry, zone 1 dominates the flow of imports from zone 2 ; for services, zone 1 completely dominates export flows to zones 2 and 3 ; and for the construction sector, flows are evenly balanced between zone 1 and zone 2.

After the opening of the Great Belt link, the model does not identify any great changes in the direction and structure of flows. In the agricultural sector, zone 3 (North Jutland) exports more to Fyn but loses its markets on Zealand and its connections with the rest of the country in the other sectors diminish. Zone 1 (Copenhagen) confirms its pride of place in greater exports of services with zone 2, zone 2 maintains its position, albeit weakened, as leading exporter in the industrial sector.

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[86] These costs are calculated for 4 transport types: trucks, trailers, rail freight and swap bodies/containers. AIDA looks at 8 groups of freight divided into 2 categories: agricultural and industrial. Finally, for each product type, transport costs include costs relating to distance, time, ferry prices, specific costs and loading or transfer costs.

[87] The Ebeltoft-Odden and Arhus-Kalundborg links.

[88] Five modes of transport are considered: car, train, ferry, coach and plane.

[89] Zone 1: East: Greater Copenhagen, Vestsjælland, Storstrøm, Bornholm;

The increase in the volume of inter-regional trade, generated by the opening of the fixed link, is less noticeable in the agricultural, industrial and construction sectors than in the services sector.

After the opening of the fixed link, the model observes an overall increase in flows for each sector of production. Zone 1 (Copenhagen) strengthens its dominant position particularly in the services sector and its trade increases more than it does for zone 2, zone 2's trade with zone 1 expands, and zone 3's trade shrinks, leading to even greater isolation, partly due to closure of the ferry routes.

The model reaches the following general conclusions :

- the opening of the Great Belt fixed link will not have a major impact on goods flows ;
- it will mainly benefit the Greater Copenhagen and Fyn regions ;
- North Jutland will suffer the most negative effects, especially if the ferry routes are closed, which poses the crucial question : are they to be maintained or not ? ;
- it is important to devise more sophisticated hypotheses for passenger traffic by introducing qualitative analyses covering reasons for travel and choice of mode of transport ;
- the basic data for the model must take account of political decisions on transport and industrial development at national level, and of political strategies at regional level.

Study of the economic effects of the "Great Belt" link

Period of the study	1990-1991
Authors of the study	AKF (local authority research institute) University of Aarhus
Objective of study	- To find a theoretical framework for economic evaluation of major transport infrastructures ; - To identify the effects of the Great Belt link in Denmark.
Methods used	- bibliographical study of the evolution of evaluation methods applied to this link ; - application of AIDA model to Danish regional economy ; - observation of structural changes in inter-regional import and export flows.
Indicators observed	Structures of the 12 regions of Denmark, 6 sectors of production, 7 types of final demand ; Import and export flows between regions of Denmark ; Transport costs, transport flows, accessibility.
Results	Major positive impact expected for the Copenhagen region and for areas closest to the ends of the fixed link ; Negative effects for North Denmark, with increased isolation and decline in trade.
Weak points	The model does not incorporate any regional or national decisions concerning transport infrastructure back-up policy. Unconnected evaluation of international economic and

	political contexts, of operators' strategies, and of the planning of other links between Denmark, Sweden and Germany and their relation to European transport networks.

Table O. HEDDEBAUT

2.6.2. Study of the effects of the Øresund fixed link[90]

The decision to build a fixed link in the Øresund strait between Copenhagen in Denmark and Malmö in Sweden, and the likelihood of the latter's accession to the European Community are the grounds for constructing a regional economic model to evaluate its effects on the Sound region of Southern Sweden. This fixed link, work on which started in 1993, will consist of a bridge for road and rail traffic.

The AKF, the local authority research institute, is in the process of drawing up a model based on previous experience of using the EMIL and AIDA models (for regional and inter-regional applications, respectively) in order to answer the following questions :

- how is cooperation between the Copenhagen region and the Sound to develop? ;
- how will the labour market react? ;
- what effects will be observed on transfrontier trade? ;
- what will be the consequences of any cultural collaboration, etc.?

To understand how the economy of the Sound works, certain essential data have to be gathered regarding :

- **flows of goods and services**, in terms of base prices by sector ; imports and exports between Denmark and Sweden and with other countries ; within the region of the Sound, public and private consumption, intermediate consumption, and investments made by the State, region and local authorities ;
- **revenue** : gross domestic product at factor cost ; transfer revenue by category ; direct taxes by sector and level (local, regional or State) ; indirect taxes by category ;
- **the labour market** : jobs per person, year and sector according to job location, home address, unemployment in the active population and category ;
- **division of the Sound region** into smaller areas approximating to municipalities.

The model for representing the economic effects of the Øresund link on the region of the Sound then covers the following elements :

- a model for the supply and demand in goods and services for each region ;
- a model for demand and revenue (Keynesian income multiplier) ;
- a model for inter-regional trade flows, within the Sound region and with the rest of the world ;
- a model for production, employment and unemployment ;
- a model for the labour market.

At this stage, the AKF researchers' study proposes an improvement in the model by trying to incorporate the "frontier effects" between Sweden and Denmark, resulting from differences between the two countries' economies, revenues and training systems.

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[90] MADSEN B., "Development of a regional economic model for the Sound", Communication au Comité de gestion de COST 317, Bruxelles, 15 janvier 1993, 7 p.

Study of the effects of the Øresund fixed link

Period of the study	in progress
Authors of the study	AKF (local authority research institute)
Objective of study	To complete the theoretical framework for economic evaluation of major transport infrastructures ; To identify the effects of the Øresund link on the Sound region of southern Sweden and Denmark.
Methods used	- application of the AIDA and EMIL models to the regional economy of the Sound ; - construction of a specific model incorporating "frontier effects" between Sweden and Denmark ; - observation of structural changes in inter-regional import and export flows.
Indicators observed	Structures of the Sound region divided into smaller areas, by sectors of production and types of final demand ; Import and export flows between regions of Denmark and Sweden ; Revenue, labour market, transport costs and flows.
Results	Not yet published (still pending)
Weak points	The model does not incorporate any regional or national decisions concerning transport infrastructure back-up policy. Unconnected evaluation of international economic and political contexts, of operators' strategies, and of the planning of other links in Denmark and with Germany and their relation to European transport networks.

Table O. HEDDEBAUT

2.6.3. Study of the combined effects of the Great Belt, Øresund and Fehmarn Belt links[91]

For the first time, Danish researchers are planning to model the combined socio-economic effects expected from the construction of the three fixed links in Denmark : the Great Belt link connecting eastern and western Denmark, the Øresund link with Sweden and the Fehmarn Belt link with Germany. These three major infrastructures would be expected to have combined economic effects but have never been the subject of a joint evaluation. The first two projects have been described above. The project for the fixed link across the 19-kilometer-wide Fehmarn Belt between Denmark and Germany has still not been approved by the authorities of both countries. Under consideration is the construction of a bridge for road and rail traffic or a tunnel for rail traffic only. The project forms part of current negotiations concerning a planned high-speed train link between Hamburg and Scandinavia.

This study is based on previous evaluations of the economic impact of the Great Belt and Øresund links. It plans to use the AIDA inter-regional model in the long term because of the amount of information to be gathered on three countries, and the EMIL regional input-output model to study internal effects in the countries. It aims to show :

- changes which could affect the competitiveness of the countries after the opening of the three links ;
- "corridor effects" and their repercussions on existing traffic flows or those induced by the infrastructures and on the structure thereof ;
- changes in choices of transport mode according to improvements made to each mode ;
- the combined effects of the three links and fresh possibilities of choice of mode on passenger traffic, regional revenue and employment.

The analysis uses a model of potential defining 100 areas representing the regions (counties) in Sweden, Norway, Finland, Denmark and the Länder in Germany. The model incorporates transport costs between areas calculated using the NextBase database[92], and expressed in journey times. It also seeks to incorporate "frontier effects", "intermodal effects" arising from enhanced competitiveness, and "effects of greater accessibility" on employment. The model presents difficulties of taking into account journey times within the same area, and these have been overcome by adopting a constant time for the particular area in question. For the time being, the model is applied to movements of goods by road using the hypothesis of the choice of journeys made according to transport costs in terms of time. The study then goes on to construct a model of traffic flows in each corridor with the aid of a gravity model using the properties of maximum entropy. This results in the establishment of a matrix of transport costs combined with a model for evaluating the new distribution of current flows according to fresh possibilities of modal distribution. The model will then be used to estimate the fresh movements generated by these fixed links and quantify the total increase in the transport market in each corridor.

The impact of the opening of the Great Belt link alone has already been described in the first case study, with the second case study doing the same for the Øresund link on its own. Combining the effects of the opening of both links shows that the Malmö region in southern Sweden will benefit more than the Copenhagen region from this new system and the positive

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[91] JENSEN-BUTLER C., MADSEN B., "Regional consequences of transport infrastructure investment : Three bridges in the western baltic", presented at the NSRSA Conference held at Kiel, october 1992, 11 p. + Cartes.

[92] NextBase, "AUTOROUTE PLUS, VERSION 5", reference manual, NextBase Ltd, Middlesex, UK, 1992.

effects will be felt as far as central Sweden. Combining the effects of the opening of the three links (the two described above plus the Fehmarn Belt link) shows that the regions close to the Danish side of the Fehmarn Belt (Lolland and Falster) will benefit most. It presents greater potential gains for the Schleswig-Holstein and Rostock-Stralsund regions in Germany. Curiously, Copenhagen and Hamburg will only experience a slight increase in potential gain. The study also looks at route changes between Scandinavia and the German cities of Berlin, Bremen and Munich for goods traffic by road in the light of completion of each of the three links compared with the situation without the fixed links. Without the links, traffic from Norway to Bremen, Berlin and Munich goes via Jutland in Denmark. Traffic from Sweden and Finland to Berlin and Munich goes via Rostock and crosses the Fehmarn Belt to go to Bremen.

The Great Belt fixed link on its own only makes a difference to routes within Denmark itself.

Study of the combined effects of the Great Belt, Øresund and Fehmarn Belt links

Period of the study	in progress
Authors of the study	AKF (local authority research institute)
Objective of the study	- To complete the theoretical framework for economic evaluation of major transport infrastructures ; - To identify the combined effects of the Great Belt, Øresund and Fehmarn Belt links on Sweden, Norway, Denmark and Germany.
Methods used	- Application of the AIDA and EMIL models to the regional economies (100 zones) of Scandinavia and Germany ; - Observation of structural changes in inter-regional import and export flows for 100 zones ; - Construction of a specific model incorporating "frontier effects" between Sweden, Denmark and Germany.
Indicators observed	Socio-economic structures of the 100 zones covered by the model, by sectors of production and types of final demand ; Inter-regional import and export flows ; Revenue, labour market, transport costs and flows.
Results	Not yet published (still pending). Preliminary results show that the combined effects of the three links are different from the sum of the effects of each link. The combination of the links will be of the greatest benefit to the Danish side of the Fehmarn Belt (Falster and Lolland), then to the Schleswig-Holstein and Rostock-Stralsund regions in northern Germany.
Weak points	The model does not incorporate any regional or national decisions concerning transport infrastructure back-up policy. Unconnected evaluation of international economic and political contexts, of operators' strategies, and of the planning of European transport networks.

Table O. HEDDEBAUT

The addition of the Øresund fixed link has an effect only on the ferry routes connecting Sweden and Germany. The combined impact of the three links, however, involves a route change for traffic from Norway and Sweden to Munich and Berlin, making use of the Øresund and Fehmarn Belt fixed links. These results could change when the model incorporates the system of high-speed rail links.

This again demonstrates the need to identify the overall functioning of a transport system since the combined effects of the system may be different from the sum of the effects of each component of the system. It would also be worth taking into account the reorganization of the European road and rail transport networks in analysing the impact of major transport infrastructures at the boundaries of the European Community territory, especially if the accession of Sweden to the Community goes ahead.

2.7 Case studies and Methods used in Italy[93]

2.7.1. Cost benefit analysis on the design of a fix crossing over the strait of Messina : the single stan bridge

2.7.1.1 Introduction

The cost benefit analysis of the design for the construction of the Bridge over the Strait of Messina involved contribution from all the teams, companies, and designers who worked on preparing the original design and the studies of the traffic flow and environment and social impacts. The approach was based on the method wich has been used and tested during the last decade by the Finance Ministry through the activities of the Public Investment Estimate Section .

2.7.1.2. Some of the selected methods

The cost - benefit analysis of a structure such as the bridge over the Strait of Messina requires methodoligical choices, to ensure that common logical guidelines are adopted for all aspects of the problem. These choices are determined by the particular dimensions of the project and its social, environmental and economic impacts and financial implications.

The basic strategy was to compare between the situation "without the bridge" to the situation "with the bridge" with regard to both costs and benefits. So, as far as costs are concerned, the starting point was to establish the present operating level of the crossing of the Strait by ferry. The investment costs (and the relevant operating costs) involved in maintaining the ferry service have been identified and quantified. These costs can be compared to the predicted investment and operating costs for the construction and the operation of the Bridge. In practice, the costs that would still have to be borne in the event of the bridge not being built are "deducted" from the costs for the construction and the operation of the bridge. Put another way, the investment costs that the community would have to bear to maintain and obviously improve the present crossing system in sopme way, must be "deducted" from the costs of constructing the bridge and its connections.

The same approach can be applied to both operating costs and benefits. Obviously, all the costs and revenue items have been considered as economic values and not as financial values. This comparison between the situation "with" and the situation "without" the bridge was carried out for every year dealt with the analysis (i.e. a fifty-year period starting from 1994, which is the year it was assumed that construction would start). It should be noted that, for the initial period, the two situations have similar features, since it was assumed that some of themeasures included in the Programme Agreement of Dec 12, 1989 have been carried out in both reference scenerios. Following this work programme, the conditions "without the bridge" and "with the bridge" have been studied up to the same level, since they lead to two different economic analyses which can be expressed by the same cost and performance index, and thus, as will be described in the following pages, by the same direct and indirect benefit index. Among these indices, particular attention should be given to those which relate to the changing attitudes towards the transport network (and not merely the Strait crossing) which will be produced by the construction of the Bridge. In order to obtain results which can describe the different service levels of the networks through synthesis quantity indices,

93 PALCHETTI M. and SPAINI G., "Cost-Benefit Analysis on the design of a fix crossing over the strait of Messina : The single stan bridge", Summary of the analysis, 1995, 16 p.

together with the different modal choices of the users, different demand levels must be compared with the corresponding supply scenarios.

The quality of supply provided by a transport networkis determined by its capacity to porvide userswith certain level of service. These levels can be described by indices such as travel time, costs, comfort, safety, etc. The level of demand is then applied to the network thus described and it becomes possible to estimate the respective levels of supply and demand - i.e. the balance between the supply and the demand. ln the economic appraisal of transport infrastructures, these factors are summarized by a group of variables which describe the features of the structures and infrastructures that determine supply. These variablesprovide a quantitative assessment of the way the level of service changes as a result of changing demand. In what follows, we shall apply a suitably precise methodologiy to this problem, which has previously only been dealt with an extremely brief and simplified way. It is nonetheless important to pay particular attention to benefits which derive from the "easier" travel and transportation which must result from the following logical stepsÊ:

- defining a measurement of the "economic efficiency" of the network in question;
- defining the network and its performance;
- estimating the demand on the studied network;
- estimating the value assumed from the synthesis parameter of economic efficiency of the network.

In the case of the economic appraisal of the Bridge over the Strait of Messina, evaluation was carried out for both the scenarios "with" " and "without" the bridge. As far as the latter was concerned, it was assumed that the ferry service would be developed and rationalized on the basis of the programmes planned by the relevant Authorities and Administrations. These developments have been stated by Istra in a study which, in addition to describing individual measures, quantifies their costs and their effect of the network. This analysis is described in detail in the chapterwhich deals with the analysis.

2.7.1.3. The scope of the work

What was carried out is obviously an interpretation of the possible approach to the "bridge problem". It also takes into account what Stretto di Messina will deduce from a complete and open to original contribution survey to increase to the maximum degree the image effect. The construction of this work programme was thus strictly connected to the capacity to fit the application af a cost - benefit method commonly used for transports to the introduction of a series of elements connected to the extraordinary features of the work under study. For example, as far as the economic effects of the project are concerned, this approach involved that the accounting of the benefits was not reduced only to the time saving (on the basis of which the "monetization" is associated to a specific "shadow value" depending on the different subjects interested in the works, individual person, goods, vehicles, etc.). On the other hand, a group of elements - that have been quantified - were introduced to allow the estimate of the work under study in all its aspects that obviously are not limited to a simple crossing structure. Briefly the scope is as followÊ:

i) estimating the economic profitability of the projectÊ:

This implies estimating of the benefits which the whole national comrnunity (i.e. families, firms, and government) will derive from construction of the bridge. The purpose of the survey was broadened to cover all direct and indirect effects connected with construction of the bridge which were monetized and included in the cost-benefit analysis;

ii) quantitative estimate of impactsÊ:

The study estimates the internal and external impacts of the construction of the bridge during both investment and operating phases. The effects associated with the construction of such a major structure are thus estimatedÊ: direct an indirect generation of employment, added value at national value, resulting economic benefits, etc.

iii) check on the sensitivity of the project :

The analysis can simulate a group of "limit situations", in addition to those included in the deterministic analysisÊ: the sensitivity of the project to these situation can thus be estimated. This group of "limit situations" is formed by a series of alternative assumptions concerning relevant variables : various predicted demand and supply scenarios, possible changes in investment costs, increased construction time, etc.

iv) to overcome the view of the bridge as a simple crossing structureÊ:

It must be remembered that the approach to the cost - benefit analysis of the bridge must not be limited to the benefits deriving from savings on the crossing, but include a wider range of factors, and all the possible impacts produced by this structure on the whole economic, social and urban system of the affected areas and regions, and indeed of the whole southern part of Italy.

2.7.1.4. Expected results

Various results are expected and they allow the estimate of different goals which are on the basis of the intervention. Particularly they can identified as follows:

i) Estimate of the economic profitability of the investment

- absolute estimate, i.e. from the point of view of true expenditure (current net economic value),
- relative estimate, i.e. with respect to alternative investment (through the rate of domestic economic growth, SRIE and the cost/ benefit ratio, RBCA).

ii) Estimate of the impacts on national and local economiesÊ:

- in terms of added value, employment,
- in the final phase of construction,
- in the operation phase,
- global estimate and estimate for different branches of economic activity.

iii) Estimate of the result of the investment in terms of "public expenditure"Ê

- absolute estimate

iv) Pointing out of the crucial elementsÊ:

- in order to determine profitability and national and local impact.

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Cost-Benefit Analysis on the design of a fix crossing over the strait of Messina :

The single stan bridge

Duration of study	from november 91 to december 92
Authors of study	Stretto di Messina Spa
Objective of study	Economic and financial appraisal of the project
Methods used	Cost Benefit Analysis
Indicators observed	- socio-economic structures of the zones affected in Calabria and Sicily, - investment, operating and external costs, - transportation benefits, - other internal and external benefits.
Results	• Internal Rate of Return : 7,86% (min), 11,87% (max), • Net Present Value (Billion Lire)Ê: 1.434 (min), 4.843 (max) at 5,5%.
Weak points	- long duration of appraisal - uncertainty about the start up of works.

3. Comparison of methods for evaluating road infrastructures

To complete the analysis by case studies in each country, it is necessary to combine on the same grid the principal methods and the different indicators observed in each country. This operation would reveal the disparities or similarities between the approaches adopted by country. They would show up, in particular, in connection with the example of road or motorway infrastructures.

3.1. Spain

Duration of study	Variable
Authors of study	Public administrations : General Roads Directorate of the Ministry of Public Works Universities : Barcelona (CEP), Madrid (Complutense)
Objective of study	To identify and evaluate the direct and indirect effects of the introduction of motorways.
Methods used	- Modelling (MOPRE model), (Keynesian multiplier) - Classification of effects according to stages of implementation of infrastructures (construction, operation) - Theoretical simulation of the effects of motorway investment on a given region.
Indicators observed	- Transport costs and flows, - accessibility, - labour market, - economic structure of the regions observed, - the land and property markets, - amount of investment.
Weak points	• Difficulty of obtaining regionalised statistical databases. • Evaluation is disconnected from international political and economic contexts and from the planning of European transport networks.

Table O. HEDDEBAUT

3.2. Netherlands

Duration of study	Variable
Authors of study	Free University of Amsterdam
Objective of study	• To study the effects of the motorway ring, especially on property and industrial location.
Methods used	- Modelling, - estimating demand (model), - possible scenarios compared to the variant without the project - bibliographical study - discussions with experts.
Indicators observed	- Accessibility (savings in time, cost, etc.), - traffic, - land and property markets, - employment, - imports and exports.
Weak points	Purely local analysis of effects

Table O. HEDDEBAUT

3.3. France

Duration of study	Three to five years
Authors of study	The studies are carried out either by Directions Départementales de l'Equipement (DDEs) or by CETEs, public bodies, to ensure a more homogeneous follow-up, and thus the ability to compare results.
Objective of study	- To follow the effects of motorways in order to draw up an "ex-post" balance sheet not more than five years after their going into service, within the framework of the legal obligations set out in LOTI. - To analyse the effects of regional strategies implemented to maximise the positive effects and alleviate the negative effects of different road infrastructures.
Methods used	*The methods as laid down by the Application Circulars of LOTI and are identical, regardless of the region crossed.* • Estimating the primary effects of transport infrastructures by observing changes in flows of passengers and goods, • Estimating the secondary effects of the Brittany Road Plan on : - local economic development, through surveys of companies and businesses, - tourism ; follow-up of use level of installations, - landscapes. • Evaluation of back-up measures taken in relation to the transport function, to take advantage of the economic repercussions while preserving the environment.
Indicators observed	*Laid down by Application Circulars of LOTI* - Savings in time and accessibility in relation to intersections, levels of safety and comfort for users, transport costs and flows - Socio-economic structures in the corridor crossed, by sector - Income, labour market in short and medium terms, location of firms, level of tourism.
Weak points	- "Judge and jury" role of public bodies. - Observation of effects of motorways over a short-term (3 years) or medium-term (5 years) period, which by definition precludes the capture of "structural" effects identifiable over longer-term cycles. - Difficult implementation of environmental follow-up. - Under-estimation of relative nature of road planning measures in relation to the national or European development policies within which they are taken.

Table O. HEDDEBAUT

3.4. Switzerland

Duration of study	1-2 years
Authors of study	- Universities : Fribourg (CRESUF), Neuchâtel (GEE) - CEAT Lausanne - Public authorities (Commission d'Examen des Routes Nationales Suisses, CERNS)
Objective of study	- To identify the effects of a motorway (or a section of highway) on the region directly served by the infrastructure - To clarify the relationship between transport infrastructure and regional economic development
Methods used	*These vary according to the infrastructure observed* - Inductive before-after method (CEAT, CERNS) - Modelling (CRESUF) - Systematic global approach (CEAT) - Statistical analysis - Cost-benefit analysis (GEE) - Analysis of regional and inter-regional traffic flows - Discussions (actors' strategies)
Indicators observed	*These differ according to method used, as do definitions* - Accessibility, size of centres served - Primary effects : employment and direct revenue from construction and operation (CERNS) - Regional distribution of revenue - Initial and induced effects : - Local property market - Industrial location - Demand for transport : (motives, O/D) - External effects : land prices (CERNS), environmental degradation (CRESUF)
Weak points	• Observation of effects in a local or regional context • Disconnection from the context of decision-making regarding the implementation of national or European networks • Observation of short-term effects

Table O. HEDDEBAUT

Conclusion

From an examination of these tables, we note that with regard to the evaluation of the effects of transport infrastructures on a national scale - especially road transport or motorway infrastructures - countries such as France, Spain and Switzerland call on the services of public authorities, university laboratories or research institutes specialising in this area.

It remains to be confirmed that identical methods, or methods comparable to each other, are being grouped under the same heading. For example, does the cost-benefit method make use of the same types of costs in each country? In fact, in some countries the studies classify costs which are met by society, such as environmental damage, pollution, etc., under the heading of the social costs of transport, while in other countries the costs are limited to the construction costs of the infrastructure itself.

In addition, the definition of the indicators observed may vary from one country to another while keeping the same name. For example, the criterion of accessibility may be measured either in terms of access to an infrastructure of the same category in the same mode, or in terms of access and/or connection to other types of transport infrastructure, when discussing intermodal aspects, or in terms of access to zones of economic development, of training, of touristic or cultural consumption, etc. It can also be measured in distance but also in time - implying possibilities of interpretation very different from country to country, especially in the case of projects for high-speed links.

By contrast, when studying the impact of missing links, especially when they have a cross-frontier aspect, the different countries, at their different decision-making levels - state or region - most often commission private research institutes or consultants.

This is particularly the case, as we have seen, for the following key links :

- The fixed cross-Channel link, for which the American research firm Bechtel was commissioned by the Nord-Pas de Calais region to evaluate the possible economic and social effects on the region. Similarly, DG XVI and CEE asked a private consortium consisting of ACT Consultants and ME&P, in association with IRPUD, to analyse the effects and repercussions of the construction of the Channel Tunnel on the European Community and on 13 specific regions in particular.
- The fixed link across the Strait of Gibraltar, the social and economic impact of which on the regions close to its outlets will be analysed by a consortium of 5 private research offices, SETEC-Economie, SEGED, SNED, Maroc Structures and EYSER.
- The new links across the Alps, the effects of which will be analysed by a consortium of private research bureaux, Motor Columbus and INFRAS, which is itself responsible for setting up the project.
- The Paris-Brussels-Amsterdam TGV line ; the first study concerning the economic and social impact on the Netherlands dates from 1980, and was entrusted to a private consultancy under the supervision of the Netherlands Ministry of Transport. A second study of the potential effects of implementation of such a line, carried out in 1992-93, was delegated to a consortium of three private consultancies.

However, it should be noted that in the case of the cross-Channel fixed link the evaluation system set up prior to the decision by the States to evaluate the impacts of the four projects proposed by the different consortia, drew on the evaluation resources of major State bodies, especially as regards the French section.[94]

Moreover, the Nordic fixed links connecting Denmark to Germany and Sweden are the subject of analyses of social and economic impact developed by a transport research institute of the Ministry of Transport, in association with studies by the University of Aarhus. This approach allows a search for innovations, such as attempts to combine quantitative analyses with qualitative elements, and to model the totality of these parameters while taking account of the imperatives of European policy laid down with regard to transport infrastructures, and especially with regard to eliminating missing links in networks.

This introduces a first series of questions. Do missing links in fact have intrinsic characteristics such that it is impossible to examine them in terms of national directives and recommendations, where they exist?

How are decisions to give an order of priority to the elimination of this or that missing link in Europe taken? At the Corfu summit in June 1994, the Council of Europe specified 11 projects as having priority, whereas the Commission mandated to evaluate possibilities of "innovative financial arrangements" and to analyse their social and economic effects on the countries where the projects were to be constructed on one hand, and on the Union as a whole on the other, has not presented its conclusions. The preliminary selection criteria described by the White Paper will therefore be studied *a posteriori*.

94 HEDDEBAUT O., "Histoire d'une idée fixe: Le tunnel sous la Manche", Recherche-Transport-Sécurité, no. 43, June 1994, pp.

4. Analysis of the assessment methods for the Channel Tunnel

by Odile HEDDEBAUT

4.1 Assessment of a fixed Channel crossing by the "Braibant-Lyall Working Group"

In 1980, at the request of the Commission of the European Economic Community the UK consultants Coopers and Lybrand were commissioned to undertake a study of the different alternatives for fixed Channel crossings in order to determine cost-effectiveness. They concluded that all the proposals were cost-effective, but they were inclined to favour the twin bored tunnel. The Conservatives were once again in power in the United Kingdom, and the Prime Minister Margaret Thatcher agreed to relaunch the project for a fixed Channel crossing, provided that this project did not include any aid or guarantee from the States.[95]

At the Franco-British summit in September 1981, the UK Prime Minister Margaret Thatcher and the President of the French Republic François Mitterrand revived the idea of building a fixed link between the two countries. The governments decided to assign to a group of experts the task of carrying out economic and technical studies relating to the tunnel. They appointed an informal "working group" chaired on the UK side by Sir Andrew Lyall, representing the UK Department of Transport, and on the French side by Guy Braibant, representative of the French Minister of Transport.

4.1.1 Comparison of the alternatives

This "Braibant-Lyall Working Group" had to examine a set of alternative fixed links, "the bored tunnels" with one or more tracks, "the submerged tunnels" made up of pre-fabricated components, the project for a "combined bridge - tunnel structure", the projects for "variable-span, multi-span suspension bridges".[96] It went on to compare the various possibilities for fixed links in the light of their estimated investment and operating costs and taking into account their technical possibilities or limits. The work of the group was also based on all the studies undertaken by the promoters of the different projects for the fixed Channel crossing in order to study the technical and financial possibilities of implementing the different alternatives. This initial technical analysis reached the conclusion that, because current technical knowledge, only the tunnel projects, bored or submerged, would allow "a rapid start on the work".

It also assessed the impacts of each solution on the economies of the two countries. In this respect, this group of experts based its considerations initially on the studies undertaken at the time of the last Channel tunnel project in 1972-1975 and attempted an initial restrospective approach to the forecast traffic data for 1980 on the basis of the years observed during this same year. It recorded observed rates of growth appreciably higher than the rates which had been forecast. Particularly in the case of passengers with vehicles (cars and coaches), for which the volume of traffic in 1980 was 30% above the forecasts, and which was in part due

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95 Heddebaut O., "Histoire d'une idée fixe: le tunnel sous la Manche". [History of an idée fixe: the Channel tunnel]. *Recherche-Transports-Sécurité*. No. 43, June 1994, pp. 35-50.

96 Braibant, G., Lyall A., Report of the Franco-British working group on the Channel crossing, "*Manche: quelles liaisons?" [Channel: which links?]*, Paris 1982, La Documentation Française, 137 p.

to the rapid expansion of coach traffic (+ 19% per annum). As far as goods traffic is concerned, the observed values in 1980 showed growth in road traffic to be one third above the 1975 forecasts. This has increased by 18% per annum, and its share of total traffic has increased from 40% to 70% in 10 years.

4.1.2 Economic assessment

The group then carried out an economic assessment on the basis of an analysis of the prospects for cross-Channel traffic. There should be competition with air traffic between the United Kingdom and the Continent only on the London - Paris and the London - Brussels routes, which would relinquish a 30% market share to a fixed link provided that it was a rail link. The experts also envisage falls in transport costs (in a margin of 0 to 30%), assuming deregulation of air transport in Europe.

As regards maritime traffic, the forecasts show that the ferry services should be able to carry a large part of the forecast increase in traffic thanks to rationalisation of maritime services and the development of higher-performance ships with greater capacity, thereby allowing reductions in transport costs. The traffic forecasts were obtained by analysis of the work undertaken by the promoters, in particular British Rail and SNCF, the Coopers Lybrand and Setec Economie study[97] carried out on behalf of the EEC in 1979-1980 and the statistics on cross-Channel traffic.

The processes used for this economic assessment make use of "simple economic" calculation to determine the benefits, measured in monetary terms, which can be anticipated from each solution for a fixed link. With this it is possible to arrive at a rate of return, by means of a comparison with the investment costs. Finally, several scenarios were devised. Combining all the low or unfavourable assumptions concerning a fixed link, for example an increase in costs and construction delays and a reduction in the operating costs of maritime services, produces scenario C, then consideration of the high or favourable assumptions concerning such a link produces scenario A, assessed as "very optimistic or very pessimistic but not implausible".

The traffic forecasts, both for passengers and goods, are then made on the basis of the assumptions adopted in each scenario and compared with a central scenario B. The group of experts, however, has several comments to make regarding the results obtained, which are extremely sensitive to the assumptions adopted. They put forward the importance of the trend in operating costs for ships on the Channel crossing, as well as the uncertainty regarding the tariff policies which will be adopted by the various maritime services and which might jeopardise the cost-effectiveness of a fixed structure.

In addition, the group emphasises that the report contains weaknesses, as the economic assessment considers only the aspects linked with the direct transport costs and so it does not take into account the consequences for the two rail networks of a possible road-rail transfer in the case of the railway-tunnel alternative. Furthermore, the prospects of a new allocation of the costs and benefits of the different alternatives between regions or between countries have not been studied. The impacts on employment and local development of various fixed-link

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[97] Coopers Lybrand, Setec Economie, "Study of the community benefit of a fixed channel crossing". Commission of the European Communities, January 1980, 365 p.

solutions have been tackled only to a very small extent and, in any case, are limited mainly to the short-term, and in particular to the direct effects of the construction site.

The group expresses the need to carry out studies of the very long-term impacts (about 50 years) of the construction of such structures and to observe the activities connected with transport, agricultural activities, the environmental impact, and the activities connected with the hotel industry, catering, commerce and tourism.

4.1.3 Conclusion

In 1982, the Braibant - Lyall report confirmed by way of a conclusion firstly that the forecast trend in cross-Channel traffic justifies the construction of a fixed Channel crossing and ensures the cost-effectiveness of the projects. Secondly, it recommended “the construction of a twin bored rail tunnel, with a shuttle service for motor traffic, phased if need be. This solution offers a certain economic advantage for the two countries, security would be increased and the energy balance improved”. This report concluded that, in view of the more reliable technical knowledge required, this solution was more likely to raise the private capital on the financial markets, provided that the two governments showed a quite definite interest.

Assessment of a fixed Channel crossing by the Braibant - Lyall working group

Length of the study	Eight months from September 1981 to April 1982.
Authors of the study	An informal joint working group set up within the French and UK Ministries of Transport, co-chaired by Mr. Andrew LYALL, State Secretary at International Transport and Mr. Guy BRAIBANT, representative of the Minister of Transport.
Objective of the study	- To examine the different alternatives for fixed links, the "bored tunnels" with one or more tracks, the "submerged tunnels" made up of pre-fabricated components, the project for a "combined bridge - tunnel structure", the projects for "variable-span, multi-span suspension bridges". - To assess the impact of each solution on the economies of the two countries.
Methods used	- Retrospective comparison of the ex ante and forecast data estimated in the last project in 1972-1975 with the data observed in 1980. - Ex ante economic and social assessment of the different alternatives using the scenarios method. - Energy and environmental assessment of the different alternatives on both sides of the Channel.
Indicators observed	- Technical feasibility of the different alternatives, level of investment and construction periods. - Maritime (cars, coaches, day-trippers) and air passenger traffic, and goods traffic (road, rail and containers). - Capacity of the various structures and of the transport networks to which the projects are linked. - Impact on direct (construction and operating period) and indirect employment, created in the short and long term. - Transport costs by rail, road, sea and air.
Results	The working group opts for the solution of the twin bored rail tunnel with shuttles for motor vehicles, technically more reliable in the short term and capable of raising private financing.
Weak points	The work of this group does not take into account structural reorganisations of the various cross-Channel transport markets. In addition, it considers only the direct transport costs without incorporating the consequences of possible road-rail transfers for the two rail networks. This study has been undertaken without any allowance for the planning of the European transport networks, or the changes resulting from the accession of new Member Countries to the European Community.

Table O. HEDDEBAUT

4.2 Impact of the Channel tunnel by SETEC and SERETE - CODRA for the "France Manche - Channel Tunnel Group" proposal

The consultancy firms SETEC Economie and Wilbur Smith and Associates carried out impact studies on the construction of a Channel tunnel, for the "France Manche-Channel Tunnel Group" proposal presented in October 1985 (subsequently to become Eurotunnel).[98]

The base years for the calculations are 1983 and 1984 for the observed traffic data and the forecasting ranges are 1993, the anticipated year for the opening of the Channel tunnel and 2003, that is after ten years' operation of the fixed Channel crossing. Some forecasts are projected on the assumption of completion or non-completion of a high-speed rail link between Paris and the tunnel.

4.2.1 The socio-economic impacts

With regard to the forecasts of the effects of the Channel tunnel in terms of jobs and economic impacts, the consultancy firms of SERETE and CODRA have also undertaken studies for the "France Manche - The Channel tunnel group" proposal.[99] They based their studies on 1982 for the demographic data (date of the last census) and 1984 or 1985 for the data relating to employment and the unemployment rates by branches and types of activity likely to be affected by the construction of a fixed Channel crossing.

4.2.1.1 Break-down of the tunnel's area of influence

Several areas of influence of the tunnel were defined in the SERETE-CODRA study of the "France Manche-Channel Tunnel Group" proposal, which was used as a basis for the socio-economic impact study of the Channel tunnel, in particular as regards employment. An initial area "of influence" of the construction site and then of the tunnel in operation takes in the districts of Calais, Boulogne, Dunkirk, Montreuil and St. Omer. A wider area "experiencing a knock-on effect" comprises Nord-Pas-de-Calais and the districts of Abbeville, Dieppe, Le Havre and Cherbourg. Lastly, a final area takes in the whole of France.

In the SETEC Economie study, the region is divided according to the INSEE [French national institute of economic and statistical information] employment zones. The tunnel's area of influence takes in the employment zones of Dunkirk, Calais, Flandres-Lys, St. Omer, the Boulonnais district and Berck-Montreuil. It should be pointed out that the five districts of the SERETE CODRA studies correspond to the 6 INSEE employment zones covered in the SETEC studies.

The SERETE-CODRA study also uses the INSEE employment zones to set out the Channel tunnel's direct area of influence. It introduces a division of this latter area into two areas of influence, the coastal area (Dunkirk, Calais, Boulogne and Berck-Montreuil) and the inland area (St. Omer and Flandres-Lys). However, the reasons for this division are not

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98 SETEC Economie and Wilbur Smith and Associates, "Traffic and revenue of Channel crossings" for the "France Manche-Channel Tunnel Group" proposal, September 1985, General Report + Report containing Annexes.

99 SERETE and CODRA, "Study of the socio-economic effects of the Channel tunnel (French side)" for the "France Manche-Channel Tunnel Group" proposal, September 1985, General report + Report containing annexes.

given, and the data obtained in this way are not used separately. In fact, we might have seen different trends for the coast or inland or to note different weighting of these two sub-areas in the whole of the territory under consideration.

The study also groups together the three ports, making it clear that they concentrate 65% of the population of the tunnel's area of influence, while maintaining its initial classification into coastal area and inland area.

The SERETE-CODRA study analyses the Nord-Pas-de-Calais region and the tunnel's area of influence in order to explain the reference position for their assessments of the effects of this new transport infrastructure. "The Nord-Pas-de-Calais region is a region in crisis and undergoing redevelopment, with a substantial migration deficit and a high rate of unemployment. Seen in the French context, Nord-Pas-de-Calais has the novelty of having experienced its first major industrial crisis (coal and textiles) before the national economic crisis. Thus, some redevelopment activities (for example the setting up of an automobile industry) were launched there at a time when it was still possible to contemplate creating or transferring major establishments. Today the situation is much less favourable and it is not yet possible to say that the redevelopment has been completed."[100]

4.2.1.2 The base socio-economic data

In order to define its reference position regarding activities connected with cross-Channel maritime traffic before the tunnel, the SERETE-CODRA study is based on the employment figures which have been assessed on the basis of estimates supplied by the chambers of commerce and industry and those of the independent port of Dunkirk, supplemented with the data supplied in the report which was drawn up in 1982 at the request of the French and British governments to learn the possibilities for and feasibility of a fixed Channel crossing, and which estimated 3,600 job affected by cross-Channel port activitites on the French side at Boulogne, Calais and Dunkirk.[101]

For each one of the ports of the straits, the study defined the direct jobs, that is the sailors and necessary office staff for the cross-Channel traffic, the linked indirect jobs, the jobs linked by inference, mainly the hotel industry and commerce, and the jobs inferred to be general. These data are presented subject to reservations regarding their reliability.

In fact, the study states "the identification of the share specific to the Channel crossing is difficult, especially in the ports with major international traffic". Furthermore, "it is extremely difficult to draw a precise line between "direct" job and "indirect linked" jobs. The shipping terminals form complex units with staff from the shipping lines, the port, SNCF, etc. We have put the technical staff working on the link into "direct jobs", and into "indirect linked" jobs we have put the forwarding agents, transport assistants, the cafés and restaurants at the terminals. The most important thing to note is that the total (direct + indirect linked) on the straits amounts to 3,900 jobs. It is a little higher than the 1982 estimate mentioned above (3,600), but consistent with the increase in traffic weighted by the increases in productivity.[102]

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[100] SERETE-CODRA, General Report, loc.cit.

[101] BRAIBANT, LYALL, Report of the Franco-British working group on the Channel crossing, "*The Channel: which links?*", Paris, Documentation Française, 1982, 137 p.

[102] SERETE-CODRA, General Report, loc.cit. p. 35.

4.2.1.3 Assessments of the socio-economic impact of the tunnel

These forecasts relate mainly to jobs in the Nord-Pas-de-Calais region, and particularly in the tunnel's area of influence.

The methodological approach of SERETE-CODRA is based on the work on rolling, 5-year national and regional forecasts made by BIPE and INSEE. The basis data used stem from the documents "Outlook for '89" in the INSEE Archives et Documents collection of September 1984 and "An employment scenario for the Nord-Pas-de-Calais areas in 1990" by F. Fontaine in the collection Profils de l'Economie du Nord-Pas-de-Calais [Economic Profiles of Nord-Pas-de-Calais], INSEE No. 1 1985. These projections have since been extrapolated for 1993 and 2003. It must be pointed out that the sociological indicators are not used to define the situations in the tunnel's areas of influence by the dates in question, an approach which conforms with the choice of indicators for interpreting the 1983 reference situation.

The forecasts made by SETEC Economie relate to the demographic, GDP and household-consumption trends in the various countries in question in the tunnel's area of influence, like the forecasts made for the tunnel's area of influence by the CODRA and SERETE consultancy firms for the years 1993 and 2003 with the addition of an initial assumption of non-completion of the Channel tunnel, which fits in with an attempt to define a "reference" trend. The SETEC studies also use the population forecasts made by UNO for the countries of Europe by the year 2010.

4.2.2 The impact of the tunnel in terms of traffic

4.2.2.1 The basic data on cross-Channel passenger traffic

The basic traffic data in the SETEC studies, which are used as a basis for the traffic estimates for a fixed Channel crossing, give more precise details of the maritime traffic which is classed according to major crossing routes, that is

The routes of the French straits with the ports of Dover, Folkestone and Ramsgate to Dunkirk, Calais and Boulogne,

The cross-Channel routes from Dieppe-Newhaven to Roscoff-Plymouth,

The routes of the Belgian straits with the ports of Dover and Folkestone to Zeebrugge and Ostend,

The Belgian and Duthc North Sea routes.

According to the data used by SETEC, total passenger traffic in the area of influence of a fixed Channel crossing rose to 46 million crossings, including 24 million by air and 22 million by sea. The French straits account for more than half of cross-Channel traffic. However, although motorists mainly make their crossings via the French straits (52%), they also use the cross-Channel (22%) and the Belgian straits (15%) routes.

Potential passenger traffic for a fixed link across the Channel is calculated in the SETEC studies for an area of influence which comprises mainly the following sub-areas:

4.2.2.2 Breakdown of the area of influence

the United Kingdom;

the 12 countries of the Continent, themselves divided into two categories with, on the one hand, the eight main countries of the Continent, that is France, Belgium and Luxembourg, the Netherlands, West Germany, Switzerland, Austria, Italy and Spain, and on the other hand, the four countries situated on the fringe, that is Denmark, Greece, Portugal and Yugoslavia;

non-European countries, a category which takes in the other European countries, apart from the countries listed above.

4.2.2.3 The traffic categories

The studies undertaken by SETEC and by Wilbur Smith Associates take the view that the traffic is broken down into segments corresponding to the traffic categories across the Channel, that is:

the passengers residing in the United Kingdom,

the Continental passengers,

the passengers residing in countries outside Europe (described as “non-European”).

If we refer to the SETEC data (reference year 1983), the cross-Channel traffic is structured according to categories of passengers, reasons for travel and country of residence. The passengers are in turn classified according to their reasons for travel, that is business, personal independent or personal package, in the light of their place of residence. Then, according to their mode of transport, that is motorists, pedestrians on day trips, ordinary pedestrians, coach passengers, coach passengers on package holidays.

4.2.3 The estimates of passenger traffic

In order to justify its traffic estimates, SETEC establishes two scenarios for growth over two periods 1983 to 1993 and 1993 to 2003 with reference to the trend in GDP, population and household consumption. In this way it obtains a high assumption based on an estimated annual growth of 2.8% in the United Kingdom for the first period and 3.5% per annum for the second period. The low assumption, in its turn, is based on forecast annual growth of 1.5% per annum in GDP in the United Kingdom between 1983 and 1993 and 2% per annum subsequently.

The assumption of non-completion of the tunnel has been taken into account in defining a reference situation. This is supposed to allow retrospective comparisons in order to assign the differences observed to the presence of the transport infrastructure.

With regard to journeys for personal, independent-travel reasons, we do not note any very major differences in behaviour according to country. France and West Germany are well represented as countries of destination or origin, and Spain seems to total a large number of planned journeys, in particular by the year 2003. As regards all travel for business reasons, and on the assumption of low growth, the countries most concerned in terms of origin or destination are France and West Germany, and to a lesser extent the Benelux countries.

As far as motorists travelling for business reasons are concerned, we find that the forecasts concentrate on a sharp increase in the importance of West Germany as a country of destination or origin for journeys. The countries deemed to be outside Europe (or not adjacent) do not appear to have a role to play for business trips by car. As far as motorists are concerned, France and West Germany should see growth just about double, despite an assumption of low growth.

As regards trips by coach, that is where the coach makes the crossing, we find the flows are divided in the same proportions as for overall demand for this type of travel, with the exception of West Germany which shows a smaller increase in flows between 1983 and 2003.

On the other hand, Spain displays particularly atypical behaviour for package trips as ordinary pedestrians, that is basically train passengers, who will triple in numbers between 1983 and 2003.

We also note that the forecasts are high for the peripheral countries such as Greece or Denmark and the countries of the Eastern Bloc such as Poland and Yugoslavia, on an assumption of high growth.

4.2.4 The basic data for cross-Channel goods traffic

Goods traffic, transported in unit batches in millions of tonnes for 1983, is itemised in the SETEC study according to the same breakdown of the tunnel's area of influence as for passengers, with the same definition of the shipping routes.

> French straits: total traffic of 5.03 m tonnes, including 4.18 as roll on-roll off, 0.09 in containers and in 0.76 waggons.
>
> Cross-Channel routes: total traffic of 2.55 m tonnes, including 2.42 m as roll on-roll off, 0.13 in containers.
>
> Belgian straits: total traffic of 4.48 m tonnes, including 4.18 as roll on-roll off.
>
> North Sea: total traffic of 8.72 m tonnes, including 5.80 as roll on-roll off, 2.55 in containers and 0.37 in waggons.

The ex ante studies do not provide us with information on the strategies of the carriers as regards the choice of routes for making Channel crossings, nor on the organisation of the logistical transport chains using the Channel maritime crossing.

We may, however, wonder about the possibilities of comparing these forecast data for the years 1993 and 2003 as the economic, and above all the political context changed between 1983 and 1993. In fact, the expansion from a Europe of six to a Europe of twelve between 1983 and 1993, particularly with the accession of Spain and Portugal in 1986, the fall of the Berlin Wall in 1989, which was to lead to the reunification of the two Germanies, the opening up towards the countries of the east and the dismantling of the Soviet bloc should lead to different behviour in terms of travel.

Obviously, to that there must be added the new conditions for movement within Europe as laid down by the Single European Act in 1987 and implemented since 1992 in accordance with the Treaty of Maastricht.

Impact of the Channel tunnel by SETEC and SERETE-CODRA

(France Manche CTG Proposal)

Length of the study	9 months from December 1984 to September 1985
Authors of the study	SETEC Economie and Wilbur Smith and Associates SERETE and CODRA
Objective of the study	- To estimate the passengers and freight traffic trends - To identify the Channel tunnel impact on employment
Methods used	- Scenarios up to 1993 and 2003 compared with "no-change" variant using high and low assumptions - Projection of the previous years employments curves up to 1993 and 2003, taking into account the INSEE previsions.
Indicators observed	- the tunnel's area of influence - direct and indirect employments - passengers and freight traffics - evolution of the population in the european countries and of the GDP
Results	An increase of passenger traffic for France , West Germany and Spain.
Weak points	The study cannot consider the new conditions for movement within Europe. Evaluation is disconnected from international political and economic contexts and from the planning of European transport networks.

Table O. HEDDEBAUT

4.3. Evaluation of the impact of the Channel fixed link by BECHTEL [103]

The revival in the early 1980s of the idea of building a fixed link between France and the United Kingdom resulted in the Nord/Pas-de-Calais Regional Council analysing the regional impact of such a project. The Council in turn commissioned a study from the Bechtel consultancy firm to examine the positive or negative effects of the different possible variants of the fixed link.

4.3.1 Evaluation of the impacts of a fixed link

The Bechtel study was carried out in late 1984/early 1985. It consists of an "ex-ante" evaluation based on the method of using different scenarios with a variety of parameters. Since no final choice had been made as regards the type of fixed link to be built, the method used involved examining two possible variants. Variant A (rail shuttle) proposed a rail tunnel with special shuttle cars for carrying road vehicles ; Variant B (rail/road) proposed a set of bridges and tunnels for road traffic, plus a tunnel for rail traffic.

The evaluation of the effects of the Channel fixed link can be divided into four stages :

1. Detailed analysis of proposed variants ;
2. Description of the regional economy and communications network on before-and-after basis if no fixed link was built ("no change" scenario) ;
3. Drawing up of hypotheses for traffic for different variants, and identification of impact in terms of new traffic or traffic diverted through the region and employment created or lost in the various sectors of the regional economy ;
4. Proposed specific measures for implementing a regional strategy for identifying and exploiting potential positive effects of the different variants and alleviating the negative effects.

The reference year for forecasts is 1984. Indicators observed are actual traffic flows, by category of persons travelling and goods. From these data the study draws up forecasts for traffic flows for each coastal region by various dates : 1990, 2000 and 2005. It analyses diversions of existing traffic towards the fixed link for each variant. The traffic flows by category and volume are used as a basis for deciding what communications networks need to be built and for drawing up a regional back-up strategy.

4.3.2 construction and operation impacts for each variant

The impact of construction is examined for each variant in terms of direct and indirect employment and in terms of organization of the sectors affected by this phase of the project, in particular construction and civil engineering.

The impact of putting into operation is then estimated for direct or indirect employment generated by operation of the fixed link, and for jobs lost connected with cross-Channel shipping activities.

Finally, the study of the impact of the period of operation of the fixed link over the longer term concludes that there will be continued growth in employment both in the ports and in

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103 Bechtel France, "Impacts et perspectives pour la région Nord/Pas-de-Calais du lien fixe transmanche", for the Nord/Pas-de-Calais Regional Council, Lille, August 1985, Volume I: main report, 124 p., Volume II: Annexes, 82 p.

connection with the fixed link as a result of the overall increase in traffic forecast for this period.

4.3.3 Definition of a "back-up strategy"

The document stresses the need to implement a regional strategy supporting this new infrastructure and indicates a number of essential lines of action for achieving the cumulative effects of the investment represented by a transport infrastructure of this sort. These recommendations, relating to unilateral or joint measures by the public authorities, Regional Council, port authorities, local authorities, private sector or contractor, are summarized in the following list :

1. Measures to maximize regional participation in construction of the Channel fixed link. (Investment in ongoing construction work for road or rail infrastructures, improvement and extension of road infrastructures connected with the fixed link (motorways, coastal bypass), information campaigns for regional company heads, specific vocational training, mobilization of regional research in relation to construction requirements, etc.) ;
2. Measures concerning passenger and goods traffic generated by the new link (promotion of regional tourism, increase of regional tourist accommodation and catering facilities, development of urban centres, renovation of historic sites, commercial and leisure services close to the end of the link, service areas for goods traffic, etc.) ;
3. Measures to maintain regional port activities (extension and improvement of existing installations and services, creation of back-up services, etc.) ;
4. Measures to attract other industries (setting up of zones of cooperation near the terminal, creation of a free zone, establishment of industrial estates and shopping centres along major routes, etc.).

Most of these recommendations were included in the "Cross-Channel back-up plan"[104], then discussed with the State and given contractual form in the "Cross-Channel planning contract"[105] in line with procedures laid down in the process of decentralization in France since 1982.

These measures have not yet been the subject of precise evaluation which would enable the effects of measures backing up major transport infrastructure projects to be assessed in the longer term. Subsequent discussions held jointly between the General Civil Engineering Council, DATAR[106] and OEST[107] reflect the same concern to exploit major transport infrastructures and show that it is necessary to establish programmes to back up such projects[108].

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104 "Lien Fixe Transmanche. Eléments pour un plan de développement de la région Nord Pas de Calais", file presented to the French President by the President of the Nord/Pas-de-Calais Regional Council, Lille, 20 January 1986, 35 p.

105 "Plan Transmanche", protocol between State and Nord/Pas-de-Calais Region, 14 March 1986.

106 DATAR: Délégation à l'Aménagement du Territoire et à l'Action Régionale

107 OEST: Observatoire Economique et Statistique des Transports

108 G. Gac, Y. Huart, V. Chetaneau, "La valorisation économique des grandes infrastructures de transport", OEST, Paris, January 1989, 101 p.

Evaluation of the impact of the Channel fixed link by BECHTEL

Period of the study	end 1984 - first quarter 1985
Authors of the study	Bechtel France consultants
Objective of the study	- To identify the impact of different variants of the cross-Channel fixed link on passenger and goods traffic, and on employment by sector in the Nord/Pas-de-Calais region ; - To draw up a national strategy to maximize the positive effects and alleviate the negative effects of the various fixed link solutions.
Methods used	- Estimate of changes to passenger and goods traffic along the coast and in the Nord/Pas-de-Calais region ; - Drawing up of scenarios for traffic and employment during construction of fixed link (short term), putting into service (medium term) and period of operation (long term).
Indicators observed	- Socio-economic structures of coastal area by port zones and of the Nord/Pas-de-Calais region by sectors ; - Revenue, labour market, transport costs and flows.
Results	For each variant, the study forecasts an increase in regional employment, subject to implementation of back-up measures. It expects cross-Channel activity from Calais to be maintained, with the same traffic volume as in 1984 until the fixed link becomes operational, and disappearance of traffic from Boulogne except for excursions.
Weak points	- The study does not specify the economic or social basis for the recommendations and back-up measures put forward ; - Unconnected evaluation of international political and economic contexts and of planning of European transport networks.

Table O. HEDDEBAUT

4.3. Evaluation of the Effects of the Channel tunnel by the EEC

The study carried out by the consultants at the request of DG XVI comprised two stages. [109]

The first consisted in devising a method (in this case, modelling) for analysing the regional effects to be expected from the opening of the Channel Tunnel.

The second stage aimed to collect a qualitative data from political figures and economic decision-makers supposed to have opinions or predictive data regarding the regional effects of the fixed link.

To carry out these enquiries, Europe was divided into four main zones :

- Great Britain and Ireland, this zone being covered by ME&P,
- France and the Benelux countries, zone covered by A.C.T. Consultants,
- Germany ; and the rest of Europe, these zones being covered by IRPUD.

The study thus yielded two types of results : quantified results derived from the model, and the collection of opinions gathered from the political and economic representatives of the different regions studied. The combination of these two methodologies allowed a refined procedure for assessing the pertinence of the results. When the results of both methods coincided, the consultants considered that they had a strong chance of corresponding to reality. In the opposite case, they reconsidered the results of the model, using qualitative data.

It is important to point out that the authors of the conclusions of the report are not participants in the operation of the MEPLAN model. This research was done at the request of DG XVI, and was completed in April 1991. The final report (399 pages), and a summary (39 pages), were submitted to the EEC in February 1992. The MEPLAN model developed in this study has also been used since then, at the request of Eurotunnel, to carry out their traffic predictions.

The model seeks to isolate the impact of infrastructure in relation to other elements. One of MEPLAN's basic hypotheses is that importations, exportations and increases of population are predictable. The transport infrastructure is the only element modelled, all the other elements being constant. This amounts to saying that the model does not produce a prediction but an estimate, all other things being equal. The model can therefore give bad results while still being a good model, if the principle of "ceteris paribus" is not respected.

This model represents the interactions between the transport system and the location of regional economic activities by applying an input-output analysis linked to a collection of fixed or variable coefficients. The demand for transport is derived from these interactions, and confirms the link between the sites of production and the sites of consumption. Models generating random sequences of numbers are used to determine choices of location and choices of mode of transport.

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[109] ACT, IRPUD, ECHENIQUE Marcial and Partners, "The regional impact of the Channel tunnel throughout the Community", Final Report for the DG XVI, February 1992, 399 p.

The model combines three matrices :

- A matrix for the location of economic activities distributed in 27 sectors (industries, services, transport, etc.) representing 33 zones within the EEC, including 13 special zones requested by the DG XVI, in relation to 4 zones outside the EEC.
- A matrix representing the mechanisms of commercial flows (goods in tonnes per day and passengers) in relation to transport flows (goods differentiated by type and passengers by reasons for journey).
- A matrix describing the characteristics of transport systems by network and by mode, with a series of options (B, C, B1, C1) reflecting the degree of realisation of back-up programmes linked to the Channel Tunnel or otherwise, compared to the situation without tunnel (A).

The study plans four periods of observation every five years between 1986 (reference year) and 2001.

MEPLAN concludes that the Channel Tunnel is likely to have only a few effects. Moreover, it will be difficult to distinguish these from the expected effects, probably of greater amplitude, of the opening of inter-Community frontiers. For example, the foreign trade of Great Britain with the rest of Europe amounted to only 34% before 1973, the year of its entry to the EEC, as against 66% at present, without any notable changes, other than the introduction of Jumbo ferries, in the transport infrastructures. The principal effects of the Channel Tunnel on regional development are shown by the three following maps :

This model was the subject of a presentation to the members of the Management Committee of COST 317 and gave rise to discussion both of the hypotheses underlying the model presented and on its results. We present here the principal comments made by the Group.

4.4.1. The hypotheses underlying the model

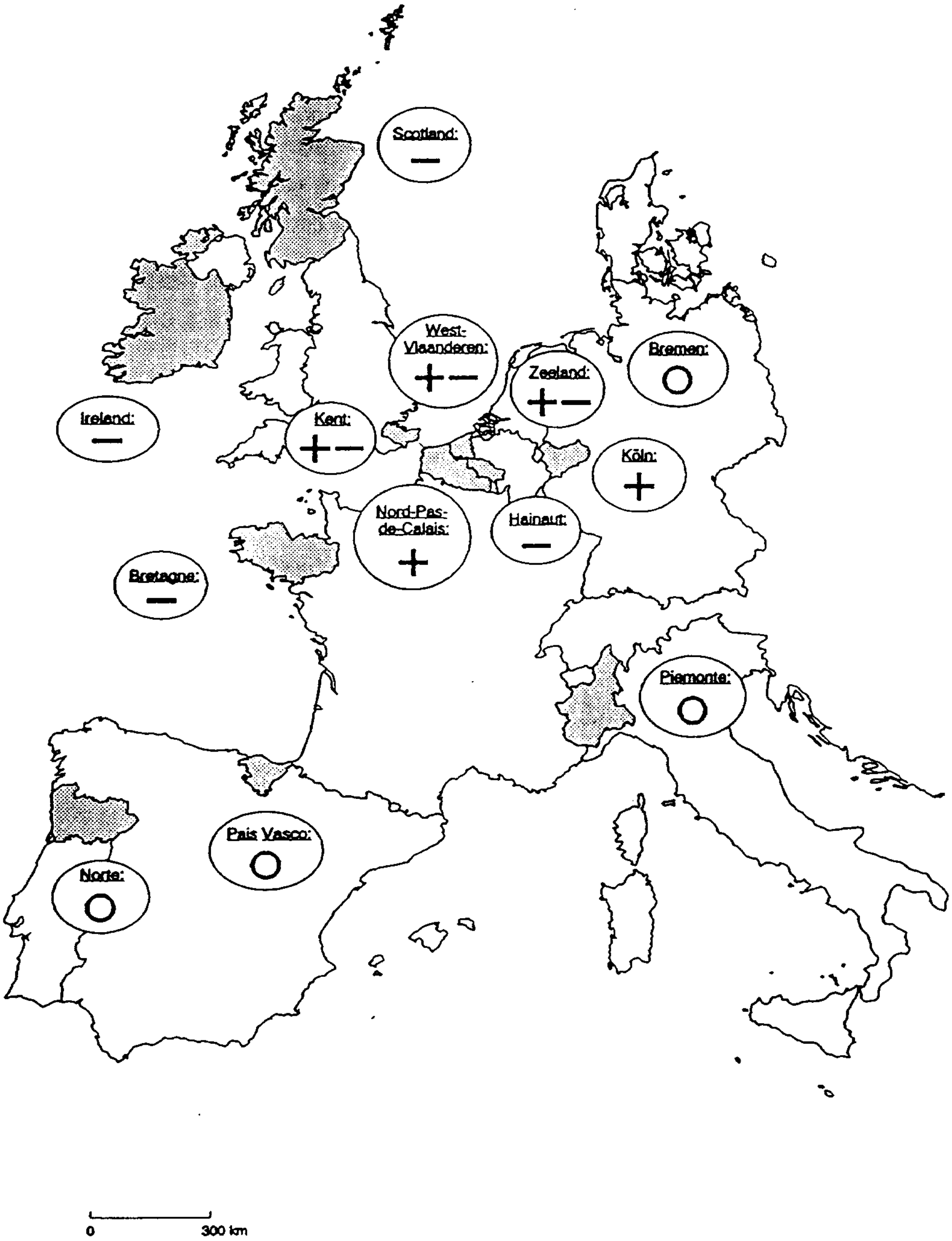
4.4.1.1 The Objectives of the model

It is important to define at the outset the objectives and uses of the model. In fact, the hypothesis that only the fixed coefficients applicable to all regions should be noted may be appropriate on the macro-economic level, but can give rise to errors on the micro-economic level. It seems necessary to introduce economies of scale and technical progress into the model, and thus to leave open the possibility of modifying the technical coefficients. In the case of the MEPLAN model, these are average coefficients.

4.4.1.2 The regional impact

The study does not give a preliminary definition of "regional impact" and does not define the time-scale, short or long term. It does not take account of movements or relocations of economic activities, nor of their structural operation during the observation period. Likewise, the system of production may itself modify the possibilities of the transport system, as seen in the introduction of stock management on the road with the development of "Just-in-Time" delivery after about 1985 ; this justifies discussion of the need to improve the motorway system. Can the model measure these changes between two observation periods ?

Map 12 - The global impact of the tunnel on regional development according to regional analyses[110]



110 ACT, IRPUD, ECHENIQUE Marcial and Partners, "The regional impact of the Channel tunnel throughout the Community", Final report for the DG XVI, February 1992, 399 p., Fig. p. 126.

Map 13 - The Impact of the Channel Tunnel and of the Associated Transport Infrastructures on Transport Flows[111]

[111] ACT, IRPUD, ECHENIQUE Marcial and Partners, "The regional impact of the Channel tunnel throughout the Community", Executive Summary for the DG XVI, February 1992, 39 p., p. 32.

Map 14 - The Impact of the Channel Tunnel and of the Associated Transport Infrastructures on Economic Development[112]

[112] ACT, IRPUD, ECHENIQUE Marcial and Partners, "The regional impact of the Channel tunnel throughout the Community", Executive Summary for the DG XVI, February 1992, 39 p., p. 34.

4.4.1.3 The transport networks

The model uses percentages of passenger entries, which amounts to using the current capacities of the networks with the current tariffs.

4.4.1.4 Transport costs

The model uses market costs as its base data - that is, the tariffs applied by the different modes and accepted by transporters. It does not take account of support policies or of direct or indirect subsidies, whether national, regional or local, to this or that mode of transport, or of the "external costs" or "social costs" generated by the use of different modes of transport, because of the difficulty of calculating them or deciding who should bear them. The whole MEPLAN model is based on transport costs, journey times and a variable called the "cost of comfort". This negates the possibility of the existence of strategies on the part of actors, or specific organizations within the transport channels, which depend on factors other than cost or time.

4.4.1.5 Statistical data on flows of goods and passengers

In the reference year of the model, 1986, statistical data on flows of passengers and goods were available (although often not homogeneous from one country to another). But with the introduction of the single market and the free circulation of people and goods on 1 January 1993, European experts, especially those working on COST 312, emphasised that the elimination of customs frontiers within the EEC would remove the principal sources of statistics on intra-Community transport flows. Setting up a replacement system is not always effective. The resulting impoverishment of information on traffic will be reinforced by the "privatisation" of major national transport groups in Europe, which from now on will regard their flow statistics as confidential. This applies to all experts whose work has a bearing on transport flows. The main questions therefore concern the future data on flows which will be input into the model, and on the way ME&P intends to observe or quantify the flows.

4.4.1.6 The tariffs of different transport modes

How can tariffs be predicted, given the secrecy in this regard practised by Eurotunnel and other cross-Channel transport operators for very understandable commercial reasons? In practice, MEPLAN adopts hypotheses based on a reduction in the tariffs of maritime companies to compete with Eurotunnel, starting from the prices currently in force, or more probably from an adjustment of Eurotunnel's tariffs to the current tariffs of the ferries, to meet the increase in investment costs.

4.4.2. The operation of the model

4.4.2.1 The reversibility of the model

The MEPLAN model sets out from the characteristics of the regional economic structure (production, consumption, location of economic activities, etc.) in defining predicted transport flows. Might it be possible to make it operate in the reverse direction? In other words, could scenarios of predicted flows be created in relation to the introduction of a fixed link (missing link), from which possible modifications to the regional economic structure studied could be deduced? Could one obtain the effects of elements of a regional economy other than those input into the model?

4.4.2.2 The operational relevance of the model

Models of general equilibrium, which are MEPLAN's frame of reference, are used to analyse reversible marginal modifications close to the point of equilibrium. However, in the case of the Channel Tunnel the change observed is very far from the point of equilibrium and is irreversible. The principal risk is that major transformations change the base data of the system observed, and that, over time, the inputs introduced will no longer be valid or will no longer reflect the reality one is seeking to model.

4.4.2.3 The sensitivity of the model

No regional statistics, or very few, exist, and the models generally use keys for translating national statistical sources into regional data. It would be interesting to know in detail how the regional variables of MEPLAN are determined. Are the same keys used in each regionÊ? Are regional weightings decided solely on the basis of these keysÊ? Bearing in mind the manner of obtaining these regional data, is the model's degree of predictive precision significantly different from its degree of uncertaintyÊ?

4.4.2.4 The equations and correlations used in applying MEPLAN

The mechanisms of the model used seem insensitive to major changes which have occurred since the reference period (1986), such as the reunification of the two Germanies, or the disintegration of the Soviet Union. Does this mean that the model's hypotheses consider that the global volume of imports and exports relating to these countries will not changeÊ? Has ME&P carried out recent work (later than the early 1980s) which takes account of these new factors? And how has MEPLAN made its latest predictions of Eurotunnel trafficÊ? Transport should be considered as a whole system. Can MEPLAN be modified, and if so how, to include the structure of networks and to calculate its effects? If the totality of transport infrastructures are combined, would one not observe a greater advantage than that predicted by the modelÊ?

4.4.3. The results of the model

4.4.3.1 The effects of the Channel Tunnel

The results obtained are presented in the form of maps showing proximity to transport infrastructures. Is it really necessary to use such a cumbersome model to demonstrate thisÊ? The MEPLAN model overestimates the effects in peripheral regions and underestimate them in central regions. This is due to the adoption of a very strong basic hypothesis. It is assumed that the different technologies within the EEC will converge. This implies that peripheral regions will have a higher growth rate than the central regions (with the possible exception of Germany).

4.4.3.2 Transport costs

The model estimates that on average the transport cost component accounts for less than 5% of the total cost of products, so that it is not fundamental in deciding where to locate activities and exchange structures. Transport's role is more important in terms of accessibility than of cost. It is therefore necessary to measure these two effects.

4.4.3.3 Back-up strategies and policy instruments

The model does not seem to take account of the different back-up policies or instruments put in place to anticipate the effects of the Channel Tunnel. Is it possible to include these in the model and in what form? In practice, in the case of the "East Thames Corridor", the effects shown by the model are underestimated, since it incorporates only the transport system and the local economic structure, without considering political directives relating particularly to this area (jobs, firms, location of activities, etc.) or specific local assistance. In addition, the results from the model can provide local actors with information on especially sensitive zones. Does the model enable measurement of these "reaction effects" of the local actors? Finally, is it possible to feed back into the model the changes to its results caused by the *a posteriori* actions of political or economic actors in the zone?

4.4.4. The General Results of the Study

4.4.4.1 The qualitative analysis

Two techniques regarding the use of questionnaires have been combined. The surveys are either homogeneous or specific to the regions considered. As a general rule, priority is given to qualitative analysis when it reveals anticipated strategies and actions on the part of the regional actors ; by contrast, priority is given to the quantitative results of the model when the qualitative analysis indicates that local actors do not anticipate repercussions.

4.4.4.2 The time frame of the study

It is essential to be able to validate the results of this study *a posteriori*, while estimating the changes to the economic structure of regions. This exercise has already been carried out in Spain and Brazil. Verification of the application of MEPLAN to the Barcelona tunnel, to the bridge at Bilbao and to the Sao Paolo underground railway has shown good adaptation to predictions.

4.4.5. Possible Improvements

4.4.5.1 The regional impact

MEPLAN could be improved as regards determination of the coefficients characterising regional situations. "Zoom effects" should be used by introducing specific coefficients.

4.4.5.2 Operating the model

The model is very cumbersome to manipulate - could it not operate with a reduced number of variables, effectively representing the zone studied by data gathered specifically for this purposeÊ? It seems realistic to construct a system of appropriate test points to be used in accurately measuring real traffic, possible relocations of economic activities, creation or loss of jobs, etc., and thereby to determine *a posteriori* the structural changes, or "structural effects", within the zone.

Study on the effects of the Channel Tunnel by the EEC

Period of the study	Carried out at the request of DG XVI of the Commission of the European Communities following a European Parliament Resolution in September 1988 - begun in July 1990, completed in April 1991, report submitted February 1992
Authors of the study	Two private consultancies and one university institute - ME&P (Cambridge UK) for Ireland and the United Kingdom - ACT Consultants (Paris France) for France and Benelux - IRPUD (Dortmund University) for Germany and the rest of Europe
Objective of the study	To analyse the effects of the Channel Tunnel on 33 areas within the EEC, 13 of them European regions specified by DG XVI in advance and 4 areas outside the Community
Methods used	. Quantitative modelling (MEPLAN model) of the regional effects of the tunnel, . Qualitative analysis by surveys (standard or specific questionnaires) of decision-makers and political, economic and social figures in the regions studied, . Combining the results of the two methods in order to determine the probable effects of the tunnel, . Comparison with the situation without a tunnel.
Indicators observed	- siting of economic activities in 27 sectors (industry and transport services), - analysis of traffic flows (tonnes of goods and passengers per day) and transport flows (of goods, by type, and of passengers, by reason for travel), - details of the transport network by network and by mode (cost, time and comfort) including options, - additional programmes connected with the tunnel.
Results	. The tunnel should have very few effects except in those regions near the mouths of the tunnel
Strong points	- combines quantitative forecasting techniques with data from qualitative analysis
Weak points	- does not specify the methods used to convert national statistical data into regionalized data, - the model takes as a basic assumption convergence of technology within the EEC (and hence more vigorous growth in peripheral regions) and thus overestimates the impact on these regions and underestimates the impact on central regions, - the model takes no account of the policies of decision-makers nor of the organization of transport in networks, nor of political directives (employment, business, siting) or specific aid to certain areas, - no account is taken of structural changes in production systems nor of political changes since 1985

Table O. HEDDEBAUT

PART THREE : TRAMELAN SEMINAR ASSESSMENT OF MAJOR INFRASTRUCTURES

Following the compilation of the interim report on COST action 317 "Socio-economic effects of the Channel Tunnel", the Management Committee organized a seminar to compare and contrast the reactions of European experts in the field of evaluating transport infrastructures. [113] The experts were invited to produce a note of a few pages on the FebruaryÊ1995 interim report, which has been incorporated into this summary.

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[113] Members of the COST 317 Management Committee taking part in the Tramelan seminar :

Mr Franois PLASSARD, (Chairman of COST 317)

Mr Claude JEANRENAUD, (Vice-Chairman of COST 317)

Mr Pardip BANS

Mr Francis CHEUNG

Mr Guy JOIGNAUX

Mrs Odile HEDDEBAUT

Mr Eddy VAN DE VOORDE

Experts invited to the Tramelan seminar

Mr Nagib BENCHEKROUN

Mr Frank BRUINSMA (representing Mr Peter RIETVELD and MrÊPeterÊNIJKAMP)

Mr Andrew BURCHELL

Mr Ken GWILLIAM

Mr Rico MAGGI

Mr Dominique SCHWARTZ

Mr Roger VICKERMAN

1. Reactions to and observations on the interim report by the experts

Contributions were made by the following participants:

Mr Nagib Benchekroun

Mr Frank Bruinsma

Mr Andrew Burchell

Mr Francis Cheung

Mr Ken Gwilliam

Mr Rico Maggi

Mr Dominique Schwartz

Mr Eddy Van de Voorde

Mr Roger Vickerman

1.1. Comments by M. Nagib Benchekroun

Je voudrais tout d'abord rendre hommage aux participants de l'action COST 317 pour la qualitŽ des travaux effectuŽs et pour la prŽsentation claire et ordonnŽe des rŽsultats de ces travaux, au moyen notamment des fiches - projets.

Le Rapport montre clairement que les pratiques d'Žvaluation des effets socio-Žconomiques des grands projets d'infrastructure de transport sont encore en train d'Žvoluer et qu'il n'existe pas ˆ l'heure actuelle de thŽorie unanimement admise qui puisse expliquer, avec une certaine rigueur scientifique, la relation entre transport et dŽveloppement.

L'analyse cožts - avantages a perdu de sa primautŽ pour devenir une mŽthode parmi d'autres et les diffŽrentes approches modŽlisatrices pour prŽvoir les effets sont utilisŽes avec de plus en plus de prudence ; la croissance et les emplois ne suivant pas de faon automatique la construction et la mise en service d'une nouvelle infrastructure de transport.

On peut regretter l'absence d'une prŽsentation faite directement par les auteurs (Consultants) des mŽthodologies prŽsentŽes, ainsi que leur rapport critique, soulignant leurs propres doutes ou hŽsitations lors de l'adoption de certains paramtres ou de voies mŽthodologiques.

Le rapport n'insiste pas de manire significative sur le cas propre du Tunnel sous la Manche et sur l'identification et la sŽlection des mŽthodologies les plus applicables ˆ son contexte spŽcifique.

La rŽflexion relative aux bases de donnŽes, bien que dŽbordant sur le domaine de l'action COST 312, n'a pas suffisamment retenu l'attention des auteurs du Rapport. A titre d'illustration, les deux SociŽtŽs d'ƒtat espagnoles SECEG et marocaine SNED, en charge des Žtudes du lien fixe du DŽtroit de Gibraltar, Žditent depuis 1993 une compilation annuelle d'une base de donnŽes socio-Žconomiques et de flux de trafics Europe - Afrique, baptisŽe DATTAR. Ces Žditions sont bien entendu ˆ la disposition des chercheurs et experts qui en ressentent l'utilitŽ.

Le Rapport relve clairement le fait qu'une rŽgion dispose d'une bonne infrastructure de transport est une condition nŽcessaire mais non suffisante pour assurer son dŽveloppement. La capacitŽ du milieu politique, Žconomique et social ˆ se mobiliser pour mettre en place une stratŽgie d'accompagnement conditionne le dŽveloppement, pour la zone considŽrŽe, des effets structurants de la construction et de l'exploitation de l'infrastructure majeure de transport.

Avec cette mobilisation, il est ainsi raisonnable d'espŽrer ˆ long terme d'un effet intŽgrateur puissant de l'infrastructure internationale de transport sur les 2 rives que le projet veut relier, comme c'est le cas pour le DŽtroit de Gibraltar. Lorsque ces deux rives ne sont plus qu'ˆ une demi-heure de distance l'une de l'autre, on atteint lˆ le domaine des trajets de type urbain, ou du moins appartenant ˆ un mme tissu urbanistique, ce qui laisse prŽsager des grandes potentialitŽs d'Žchange que peut apporter un amŽnagement des deux rives stimulant l'urbanisation de la zone locale.

On pourra alors par exemple habiter chez soi et rester attachŽ ˆ sa terre, sur une rive, tout en allant travailler ou faire ses courses dans la mme journŽe sur l'autre rive. La prŽsence future d'un systme de transport rapide pourrait ainsi unifier les hommes sans les dŽraciner. Pour le projet du Lien Fixe par le DŽtroit de Gibraltar, il semble clair que si ˆ sa mission de transit international, on pouvait ajouter une mission d'intensification et de dŽveloppement des liens urbains entre le Nord du Maroc et le Sud de l'Andalousie, on amŽliorerait sensiblement l'Žvaluation Žconomique du projet. Ces ŽlŽments restent pour le moment ˆ considŽrer.

Si la recherche initiŽe par l'action COST 317 se poursuit, il serait alors possible de sŽlectionner quelques effets socio-Žconomiques concrets, les plus simples ˆ identifier et ˆ mesurer, pour se concentrer sur leur Žvaluation.

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1.2. Comments by Mr. Frank Bruinsma

It is obvious that the analysis of the socio-economic impacts of transport infrastructure needs more attention. Even so it is obvious that quantification of those impacts is to prefer above a more qualitative analysis. The interim report on the socio-economic effects of the Channel Tunnel can be seen as an inventarisation of the approaches used and the results found within Europe. The next step will be the construction of a number of recommendations for the evaluation of major infrastructure projects.

I have the insolence to give some first ideas about such an overall approach.

In the Netherlands an environmental effect study is compulsory to all major infrastructure projects. Within this environmental effect study economic and traffic safety aspects are considered, although there are no standard approaches prescribed. To achieve such a standard approach to measure the economic impacts, recently a handbook of economic impacts of infrastructure is written.

My proposal is in line with this handbook of which I am one of the authors.

Three phases are distinguished :

1. The **planning** and **design** phase concerns mainly the costs of labour. It is relatively easy to quantify the effects in this phase.
2. The **construction** phase concerns the costs of construction and the temporary labour input. The costs of the infrastructure project are known and also the temporally labour input can be quantified.
3. The phase of actual **use** of the new infrastructure is split into separate effects: system effects and spread effects.

The system effects are measured by the benifits of travellers. By the 'rule of half' the prosperity growth by the infrastructure project for the society can be measured. Included in the 'rule of half are the decline in travel costs and in travel distance for each origin-destination link. The origin-destination links are given by the traffic model used to estimate the traffic flows with and without the new infrastructure.

The hardest problem of all is to measure the spread effects. Here we have the problem of the geographical size of the area under study. If the area is chosen too small, one might measure generative effects which are distributive on a higher level of spatial aggregation. On the other hand one has to admit that both effects are important. Distributive effects are of importance for planning agencies to steer certain developments to desired locations, or to prevent developments on undesired locations.

Another difficulty concerns the possibility of double-counting. If you measure productivity growth, company investments, employment growth etcetera all together one is assured of double-counting. The opinions on double-counting are rather divers within the European Union. On the one hand the English only measure the system effects. They argue that after a while system effects are translated in locational effects. In other words the benefits of the travellers become the benifits of the landowners.

On the other hand the Germans quantify nearly all aspects one might think of, without making any concern about double-counting. In the Netherlands we chose the safe way in between. We only try to measure the structural employment growth as a proxy of all spread effects. The employment growth is the main aspect most policy makers are interested in.

The way to measure the employment growth will be qualitative. It is mostly measured by a entrepreneurial questionnaire.

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1.3. Comments by Mr. Andrew Burchell

1. The fact that major transport infrastructure projects, such as the building of the Channel Tunnel, may give rise to a wide range of socio-economic effects has been recognised for some time in the UK. The problem, however, is largely one of identifying, measuring and valuing such effects, and assesing how the values from any analysis can best be incorporated into the main body of the appraisal.

2. The Cost 317 report discusses a wide range of methodological tools available for measuring and valuing socio-economic effects, and highlights the serious problems associated with developing a standard methodology for appraisal. Many of the methods explored have been employed in the UK as part of the wider appraisal methodology for large infrastructure projects (for example, the appraisal of the UK Channel Tunnel Rail Link, CTRL, as discussed below), but to date no standard framework has emerged. In part, this is due to the fact that the available methodologies are not yet fully developed.

3. The UK Government's policy is that, where possible, major infrastructure projects should be financed and operated by the private sector, and the initial investment costs should be recovered through user charges once the infrastructure is functional. However, in many cases, the failure of the market to take account of the external benefits of a project may create a financing gap that requires public funding if the project is to proceed. Where public funding is required, the Department of Transport (DoT) and/or the relevant local authorities are closely involved in any assessment.

4. The DoT's methodology for appraising large infrastructure projects stems mainly from its appraisal methods for major trunk and local highway schemes. This methodology incorporates a conventional economic cost - benefit analysis and an environmental assessment. However, while wider socio-economic effects are often examined, they do not form part of the main body of the appraisal.

5. Indeed, the fact that socio-economic effects exist does not in itself justify a detailed analysis. In some cases, the economic case for proceeding with a project may be so overwhelming, and the likely non-user impact small, that an appraisal of such effects would add little. Quite often, a short descriptive analysis of the likely impacts is sufficient.

6. In cases where socio-economic effects are thought to be significant, their appraisal is invariably based on hypotheses, scenarios, and assumptions about future states of the world. The assumptions that underpin an appraisal frequently rely on subjective viewpoints rather than empirical observation. Moreover, researchers encounter great difficulties distinguishing between socio-economic and other project benefits. For these reasons, socio-economic and regeneration effects are usually considered separately from the main appraisal.

1.3.1. Grant for Transport Projects in the UK

7. State funding for transport infrastructure projects igenerally available in the UK under section 56 of the 1968 Transport Act. The criteria for grant are detailed, but the appraisal methodology follows broadly the methods described above. Funding is only available in cases of obvious market faLl ure, and where user charges and local taxpayer contributions are likely to be insufficient.

8. Applications for grant are usually made by local authorities, or a consortium of public and private interested parties. Guidelines for the appraisal of projects are issued by the DoT

and include a note on the treatment of socio-economic and regeneration effects. These effects, however, are only considered in respect of areas of regional or inner-city policy priority.

9. Due to the inherent difficulties associated with estimating and valuing socio-economic and regeneration effects, no standard framework for appraisal is offered in this area. Each case tends to be different and is appraised according to the circumstances. The framework and methods for appraising such effects therefore need to be tailored to the peculiarities of the case at hand.

1.3.2. The Case of the UK CTRL

10. Many of the appraisal methods discussed in the Cost 317 report have been used in the appraisal of the UK CTRL, the planned high speed rail link between London and the Channel Tunnel.

11. As part of the general appraisal of the project, several studies were commissioned to assess potential development, regeneration, and socio-economic effects; indeed, the prospect of wider regeneration impacts influenced the Government's choice of route corridor. A number of scenarios in which different levels of infrastructure improvement and social and economic development were postulated. These scenarios were then assessed on information. gathered from interviews, property assessments, employment forecasts, and other available data.

13. The results are, however, very sensitive to the underlying assumptions. Companies and individuals may respond differently under different conditions, and in the short and long termÊ; an increase in economic activity at the local level is sometimes offset by reductions elsewhere in the economy ; and displacement effects are difficult to estimate. There is also concern over "double counting" and the extent to which the main transport appraisal may already reflect such impacts via estimates of the derived demand for transport.

14. Due to these inherent difficulties, the DoT has tended to treat assessments of this type with caution, and the values from such studies have been viewed only as indicators of the likely impact of the policy under consideration rather than forecasts.

1.3.3. The Way Forward

15. The Cost 317 report has highlighted a gap in current appraisal practices and described various ways in which it might be addressed. At the same time, it has raised several questions that remain largely unanswered.

16. One of the main conclusions of the report is that no pan-European framework for the assessment of socio- economic effects is likely to emerge in the near future. However, a prior question that needs to be asked is whether a single framework is in fact desirable; and, if so, what form might it take? Given the wide range of socio-economic impacts to be assessed, and the many appraisal methods available, a flexible rather than prescriptive framework seems desirable.

17. Many infrastructure projects do not have an international dimension and therefore impact only on the domestic economy. But in cases where there is an international dimension, such as the building of the Channel Tunnel, it would be useful to be able to compare and contrast different studies from different countries.

18. Since policy objectives may at times conflict, a ranking of objectives in order of priority may be necessary. However, given that not all member states will rank objectives in

the same order, the appraisal framework will need to be able to address the issue of subsidiarity ; that is, in this context, the right of individual member states to pursue different policy objectives.

19. The policy objectives themselves may preclude the use of certain methodological tools. Most projects are, for instance, subject to time-table and budgetary constraints, which may rule out some of the more costly and time-consuming methods of assessment, such as face-to-interviewing. It is essential, therefore, to set out explicitly the objectives, value judgements, and limitations of an appraisal.

20. In the absence of robust, widely accepted methodologies, the appraisal of socio-economic effects will continue to be treated as an addition to the main appraisal rather than as an integrated part of it. There is, nevertheless, merit in compiling a toolki t of methods within a flexible appraisal framework. Certain approaches may be more readily applied to certain types of project. Thus, for example, in cases where socio-economic and regeneration effects are likely to be small in relation to the overall net benefits, a purely descriptive assessment may suffice, whereas in other less clear-cut cases a more detailed appraisal may be justified.

21. Guidelines may also be useful for the treatment of short and long term effects. A significant issue associated with valuing socio-economic effects, which is to the estimation of discounted benefits, is the time horizon over which impacts are likely to occur. Thus, for instance, standards may be useful in setting the relevant discount rate and time horizon for a project.

22. In conclusion, a rigid framework for the appraisal of socio-economic effects seems neither necessary nor desirable. We may be better served through the development of a flexible appraisal framework, which encompasses a range of methodologies and guidelines, and promotes "best practice".

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Railways Economics
The Department of Transport
UK London
September 1995

1.4. Comments by M. Y. H. Francis Cheung

1.4.1 Problem Definition and General Recommendation

The problem of measurement is most prevalent in the evaluation of large scale transport investment and its effects on social and economic development. Improved accessibility and enhanced mobility provided by transport improvement have significant impacts on the local and regional economies. Major benefits include the improvement of job opportunities for the residents in the affected region and the stimulant that the project gives to industrial growth and relocation of offices. The effects of infrastructure investment can be organised as those stemming from, those induced by and the catalyst effect that the project enables.

In theory, large scale infrastructure project can at best restructure the regional economy and revitalize the depressed areas. In its more moderate role, it can assist and enhance the capability of other policy measures to promote strategic regional objectives. In practice, many of the claims are conjectures or working hypotheses. In the absence of hard and solid knowledge, it is not easy to provide thorough and robust evaluation of alternative schemes. Qualitative analysis helps, but it lacks the precision and focus of quantitative methods. More research and empirical studies, particularly comprehensive before and after studies, are required.

The lack of an acceptable overall conceptual framework makes it unlikely to have a single evaluation method for universal application in all circumstances. Yet, investment decisions have to be made constantly. Decision making would benefit from guidance provided by objective and impartial evaluation methodologies even though they are - at this stage of development - imperfect or incomplete. For this reason, one should consider using a mix of different methodologies that have been identified in this report in spite of their recognized shortcomings and inadequacies. One should keep constantly in mind that the methods and techniques are tools with which decision makers deploy to assist them in their endeavour to perform their tasks. Success depends as much on the potency of the tools and instruments available as on the skills and flairs of the practitioners.

1.4.2. Observations

Evaluation is a technical process and the method used serves as a tool to assist decision making. It is, therefore, vitally important at the early stage to establish the terms of reference and to define the scope of the study so that the context within which project evaluation has to be undertaken is firmly established.

1.4.2.1 Source of Funding

The primary aim of evaluations is to trace and to identify the socio-economic effects associated with all kinds of transport finance. It is useful to distinguish between different sources of funding: whether generated by internal sources (self financing) or derived from public authorities (such as grants and subsidies from the central government, provinces or municipalities). In the Netherlands, subsidies and investment fundings come almost exclusively from the central government. It is, therefore, an acceptable simplification in the development phase of analytical technique or evaluating methods not to analyse the effects of alternative funding methods. However, over time, it is an important policy issue.

1.4.2.2. Evaluation of Programme rather than Individual Projects

Any evaluation exercise is to have an indication of the socio-economic effects associated with the total transport programme. For ad hoc, small scale project evaluation, several methods are available e.g. cost-benefit analysis (CBA), cost effectiveness appraisal or multi-criteria technique. For a comprehensive analysis or an integrated evaluation of all the relevant socio-economic aspects, a methodology has to be devised.

1.4.2.3. Revenue v Capital Projects

There is a basic difference between capital projects (e.g. investment in new infrastructure) and revenue projects (e.g. extension of an existing regional or local network). However, theoretical understanding of the structural effects of different types of projects is poor and technical knowledge of the inter-relationship is even more patchy.

1.4.2.4. Generative versus Redistributive Effects

It is important to determine the effects which could have an impact on the national economy and to study the consequences on social cohesion using alternative scenario's about the likely outcomes. Only generative effects create employment and stimulate economic growth, leading to a net gain in the National Income Account. If the positive effects are gained at the expense of another region, it will be treated as redistributive because the national economy in balance will not benefit from any net gain. However, the distributive effects might be of greater importance in the political agenda and this position should be explicitly stated in the outset of the evaluation study.

1.4.3. Results And Findings From A Dutch Study

1.4.3.1. General Findings from Phase 1

i) Method of Research

Most research studies concentrated on the theoretical aspects of relationship between transport spending and the likely impacts on the economy. In several cases, methodologies had been developed in the form of mathematical or econometric models which were subsequently applied to published data to test the validity and robustness of the model. Some were case studies. A few were macro-economic studies applying statistical analyses on cross section or time series data. Some took the form of prospective studies using interviews with experts or relying on the results of questionnaire surveys. The revealed preference approach examined what firms and individuals actually did. The stated preference approach using simulation games attempted to determine what firms and individuals would do in hypothetical situations. Scenario's studies and investigations based on the Delphi technique provided some useful insights, even though such studies are largely speculative in nature and exploratory in character.

ii) Results of Impact Studies

a) Transport Programmes in General

There are few published work on the economic effects of transport improvement on the economy. Most studies were interested in the traffic effects of infrastructure investment and on changes in general mobility and not on the wider consequences of socio-economic changes. In the rare cases where socio-economic effects are singled out as topic of interest, the results were often presented in qualitative statements which ranged from assertions or claims to platitudes with little evidence to support the case. With regards to forward and backward linkages which is particularly important in the discussion of infrastructure investments, the knowledge is limited. To take the case of the High Speed Rail (HSR) projects in France, there were indications that the investment helped to stimulate the local economy and attracted new comers to locate in the proximity. But there were also counter evidences to suggest that the expected gains for the local economy did not materialise and, in the contrary, HSR worked as a suction tube and siphoned off the benefits to other regions. A possible explanation is that transport improvement reduces the need for branches in the regions and has encouraged the concentration of activities in the head office.

b) Public Transport Programme in Particular

Even less is known about the specific impacts of public transport programmes. There are several studies on the effects of individual public transport projects such as the Victoria Line Study in London or the metro railway in Los Angeles in the U.S.A. The former relied on costs and benefits analysis and the later in terms of effects on land use via changes in the rental values of property and in land prices. The central issue is: to what extent is it possible to make generalisation on the basis of a small number of case studies where local conditions often had played an important part. The indication is that transport improvement in suitable circumstances can function as a catalyst to assist other policy measures to bring about the potential benefits or to hasten the process of change. However, research studies have not been able to establish a direct causal relationship between transport improvement and changes in the productivity of firms which are located adjacent to the newly-built infrastructure.

1.4.3.2. Specific Results

i) Grouping of Major Economic Effects

Structural components - direct and indirect contributions by creating employment and generating extra values to the transport sector. The macro economic effects can be supplemented by a study of the forward and backward linkages which are second order effects.

Opportunity values - the value of public transport is assessed in terms of economic efficiency within the transport system and the consequences with regards to what would happen if this subsector no longer exists.

Impulse effects - temporary in nature caused by impulses given by public transport finance to the construction industry, delivery of intermediary materials and effects on local trades.

Radiant effects - they are additional indirect effects which affect the economic climate of the local economy and can lead to a restructuring effect in the longer term. The thesis is that improved accessibility will induce existing firms to expand and attract new firms to establish their head office or branches there. Likewise, workers and employees will be influenced by transport improvement to move into the affected area. Some research studies, particularly those by marketing specialists, argued that the effect is psychological in nature related to an improved image and a general increase in public confidence of the local economy.

ii) Estimation Methods

Production function approach - Infrastructure is treated as a separate parameter in the production function in addition to labour and capital. Investment in infrastructure by the central government is said to bring about increases in the productivity of labour and capital leading to rise in wages and salary, increase in profits or/and fall in prices. Moreover, infrastructure can reduce traffic congestions on the roads and contribute towards the smooth working of the economic machine.

Location factor approach - Transport improvement leads to reductions in journey time and travel costs. As a result of improved accessibility, the region will generate new employment by facilitating the expansion of existing firms and attracting the location of new firms in the region.

Spatial interaction approach - Infrastructure investment affects the costs of interactions and can induce drastic changes in the volume of business transactions between the regions and in turn have spin-off effects on the location of companies and families.

iii) Inventory of Economic Effects

Temporary and Permanent effects: The former refer to economic effects which occur during the period of construction primarily in the construction industry with spinoffs (impulse effects) on other business activities associated with the construction and intermediary deliveries companies. Temporary effects are one-off ad hoc effects whereas permanent effects have a more lasting nature by bringing about structural changes in economic performance in the transport and related sub-sectors.

Direct and Indirect effects: The former refer to effects of first order in those sectors that experience the impacts directly from the first hours and the later are derived indirectly via the working of the effects firstly in other sectors before having repercussions in the original sector. It is useful to know the causal relationships and to identify the sequence of chain reactions. Such knowledge can assist the planners to design more cost effective projects.

Short and Long Term effects: This concerns the duration before the effects come into force or become noticeable. In some cases, the impacts are felt quickly whereas others may take lengthy period before they work through to affect the economy. Some impacts have threshold level (or saturation point) beyond which effects become more (or less) apparent.

Internal and External effects: The former refer to the gains or losses which are experienced by the sectors which are directly affected by the transport programme whereas the latter refer to those benefits and costs which are enjoyed or paid for by others.

Backward and Forward Linkages: Backward linkages refer to changes in value added and in employment in the intermediary delivery sector. Input-Output (I-O) analysis is the most appropriate method to measure the extent of such effects. For example, as a result of public transport improvement, some car drivers and passengers are diverted to use public transport. This affects not only passenger kilometres (pkm) by car but also car ownership over time. Changes in the number of car trips affect the volume of sales by car dealers or the profit of rental companies. Garages and shops responsible for repairs and maintenance will also be affected. Foreward linkages are referred to as the radiant effects. It is purported that improvement in accessibility will induce existing firms and factories to expand and new ones to set up in the vicinity. The size of the impact will depend on the importance of transport costs or reliability in delivery of goods to the activities of the affected concerns.

1.4.3.3. Conclusions from the Interim Report

The literature survey indicated that most appraisals were based on Cost Benefit Analysis with the permanent effects as the central focus, particularly on users benefits associated with the investment project via journey time and travel costs savings. In some studies, the radiant effects were included in the evaluation e.g. trip generation by new users. In a few cases, attentions were also given to the temporary effect. With a few exceptions, direct effects such as employment and value added in the transport sector were rarely discussed.

The radiant effect is the most controversial topic. Some researchers tried to construct formal analytical models and others tried to establish a direct relationship on the basis of changes observed in regional economic development. A few attempted to adopt a more pragmatic approach and attributed the residual effects to such forces at work. However, no one has succeeded to have a convincing and transparent method that can illustrate accurately the multiplicity of the interactions. For the purpose of this study, the concepts of employment multipliers and value added multipliers were used. They were derived from statistical analyses of production statistics published by the Central Bureau of Statistics. An employment multiplier of 1.48 means that for every 10 jobs that were created in the construction sector as a result of the investment, 4.8 extra vacancies were created in the related intermediary delivery sectors and the supplying subsectors.

1.4.4. Results and Findings of Phase 2

The study has followed two different approaches simultaneously regarding them as the spearheads suitable for further investigation. The conceptual framework is to view the problem from two different vistas: the producers' angle and the consumers' angle. In **the Sector Approach**, the central issue is: to what extent does expenditure on transport programme act as an stimulant to the sector that is under discussion (including feed back repercussions). In **the User Approach**, the central issue is: to what extent does improvement in transport lead to better allocation and more efficient use of scarce resources from the societal point of view. An increase in the opportunity to make choices and in the range of possibilities for the trip-makers are conceived explicitly as a plus point. Because the two approaches have different philosophical foundations, the two set of results should not be added together.

1.4.4.1. The Sector Approach

Changes in value added and jobs creation are two major contributors to the Gross National Product in National Income Accounting. Production statistics from the Central Bureau of Statistics in the Netherlands for the period 1988-1991 were used as data source. In the input-output analyses, particular attentions centred on changes in the final demands.

i) Temporary, Direct, Internal Effects

These refer to value added and employment created in the construction and/or transport supply industries. When value added against market price is corrected for indirect tax paid and for subsidy received, one arrives at the value added against factor cost. These are made up of wages and salaries, social security tax, other incomes e.g. interest and profits. Gross values added at factor cost are used to represent the economic effects for a comparison with the amount of public transport finance. Such effects can also accrue to engineering companies and to consultants but they are relatively small, thus excluded. Another simplification is that all products are made and all transport materials are supplied by Dutch companies. Activities partly or wholly performed by foreign companies outside the Dutch frontier are discarded.

ii) Temporary, Indirect, Internal Effects

They refer to impulses given to related industries, such as intermediary suppliers and delivery companies and the chain reactions on delivery companies to the deliverers (third order effect) and so on and on. To calculate these impacts, value added multipliers and employment multipliers are derived from I-O tables over a lengthy period. These multipliers are found to be fairly stable in the Netherlands. This is not unexpected because it would take considerable time before structural changes in economic relationships can emerge. However, the multipliers can be affected by changes in technical progress and changes in business administration or in management techniques which increase labour productivity. Rising labour productivity would mean less labour is needed per unit of output.

iii) Permanent, Direct, Internal Effects

The share of the gross value added at factor cost in the total turnover is extracted from the I-O tables. On the basis of the total number of pkm travelled per year and the employment needed (measured by the number of labour years) for different operating companies, one calculates the number of labour year which is required for the production of 1 pkm. These figures are almost constant in the period 1988-1991. For the railway, the decrease in labour year per pkm represented an increase in productivity.

iv) Permanent, Indirect Internal Effects

They are related to changes in value added and in employment by the car dealer and garages (repairs and maintenance) subsectors. Increase in public transport ridership can be at the expense of car ownership and car use because many new public transport users are previously car drivers or passengers. An interesting point concerns whether the car left behind by head of the household is being used by other members of the family orbeing scrapped. In the first situation, the effects on the economy are smaller compared with disinvestment in cars. There are similar repercussion on the bicycle and moped industries as well as effects on dealers and spare parts suppliers. The effects are considered to be small compared with the efforts required so these items are not included.

v) Permanent, Additional Effects

They are primarily related to the radiant effect due to improvement in accessibility. Companies in the Netherlands change location; new companies (both foreign or Dutch) are set up and existing companies expand their activities. The scope and extent of such effects will depend on the nature of the public transport programme. It is difficult to predict the likely effects. However, a tentative attempt has been made to devise a simple method to have a rough indication of the likely effects on the Dutch economy. Analyses of the I-O tables for the period 1988-1992 and data from company registration records held by the Chamber of Commerce suggested some differences in the rate of job creation. Relocation of industries from one region to another is excluded. Remaining changes fall into one of 3 categories depending whether it is a new branch by a Dutch company or a new branch by a foreign company or expansion of an existing company in the study area. Further refinement is to allow for differences in the type of firms: production and assembling companies, sale, distribution companies or service companies.

1.4.4.2. The User Approach

The user approach is based largely on the CBA methodology and a framework has been constructed to estimate the likely effects. Most recent statistics were used and most assumptions were based on conventional wisdom with the underlying arguments clearly stated so that decision takers could decide whether they were acceptable. The approach is centred on a what-if scenario compared with the situation in a base year. The basic philosophy is the idea of getting rid of, for example, the complete public transport system at a stroke. As a result of being banished into oblivion, all public transport journeys have to be made in the new situation by other forms of transport. The community costs as a consequence of the drastic change have to be estimated. The parameters are journey time, costs of travel, air pollution, noise, traffic safety and efficiency in using travel time for business trips during the journey. Monetary valuations of these effects give the social costs of loosing the public transport system and this is compared with the amount of public finance to give the economic value.

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1.5. Comments by Mr. Ken Gwilliam,

This report has provided a substantial review, both of the major transport infrastructure projects planned by the EU, and of the appraisals that have been undertaken of existing and past projects.

The report also offers a useful overview of many of the theoretical issues which affect the problems of evaluation. That basic information is a very useful source. I agree that it is appropriate for the work to extend beyond the immediate issues of the Channel Tunnel though I feel that they may have gone too far in the wider consideration of the evaluation of major projects at the expense of too little detailed consideration of the Tunnel case itself. As a consequence it is not clear to me that the proposals contained in the paper are sufficiently practical, and I fear that they may be interpreted in a way which moves appraisal techniques in the wrong direction. My main problems concern

(i) the balance between "plurality" and "transparency" in the conclusions

(ii) the definition of what are considered to be the new "socio-economic" effects

(ii) the treatment of objectives and the implications for appraisal

(iii) the treatment of dynamic development effects and their relationship to the appraisal criterion

1.5.1. plurality and transparency

I am sympathetic with the view that we need to be broader in the elements which are taken into consideration, and more dynamic considerations in the forecasting of the underlying influences which affect the appraisal of projects. I certainly do not believe that everything can be compressed in a single figure criterion. It is the function of the technician to give the political decision maker the information which is most useful to him in a form which best clarifies the essential judgements that have to be made in a decision. To that end I think that it is necessary to observe that even for a multiple criterion analysis it is necessary to organize the information in a consistent and systematic way.

That is not always appreciated by decision makers, who may wish to obscure the real nature of their decisions. Especially when there is no clear forum in which decisions are discussed (as there is for example when multiple objectives are being discussed in the context of formal planning enquiries), the absence of such an organizing format is likely to be the basis for a retreat from objectivity in decision making. It is for that reason that I am concerned that the elements discussed in the report - the "socio economic effects" - are in many cases not definable, measureable and objectively evaluatable against some prior criteria.

In face of these difficulties with a "technico-economic" approach there has been some recourse to "opinion polling" methods - frequently dressed up in fancy titles such as Delphi forecasting, but often consisting essentially of the blind leading the blind. If these are to be the basis of the "pluralistic" approach recommended in the conclusions, it would be useful to see some evidence that they have been used effectively to forecast impacts over the kind of period, and in the degree of detail which would be necessary for them to have a useful role in project, as opposed to general strategy appraisal.

1.5.2. What are "socio-economic" effects

At the end of the introduction it is stated that COST 317 has respecified its purpose by clarifying the definitions of socio-economic effects. While I can see that the distinction is made throughout the report between the traditional transport benefits and the "socio-economic benefits", the exact nature of the socio-economic benefits is left unclear. In particular, in the sectionon types of effect (2.2) the effects are listed as accessibility, potential, location, productivity and growth. The units in which these are to be measured or expressed are not made explicit, and in the following paragraphs, which discuss methods for evaluating the socio economic effects there is reference to how they may be brought together in soof goals achievement matrix or planning balance sheet, still without any indication of what exactly they are.

Consider, for example, accessibility. What is it, and how is it measured? If it is merely some weighted average of the travel times from any location to a set of other locations it is essentially a travel benefit related measure. Even in forecasting, most models operate now on generalized cost rather than simple money cost measures. What more than this is it? Some additional qualitative dimensions could be added. For example travel time variability may be much more important than average time in affecting both person movement decisions and in forming the basis for logistics planning. The work of the Hague Consultants Group for the IRU, for example, demonstrated the relative valuation that commercial enterprises put on these other dimensions in studies in France, Germany and the Netherlands. These characteristics could, at least in principal be modelled and estimated. They could be taken into account in travel forecasting and evaluation, without requiring a fundamentally different structure for appraisal.

I find some of the other suggested elements even more difficult to cornprehend. Are the elements to be mutually exclusive and independent, as required by most exponents of multi-criterion analysis ? Are the metrics to be determined independently of any case under consideration and the methods of combining the elements defined ex ante. If these conditions are not met the approach loses all objectivity and the decision is simply what the decision maker chooses it to be, without any guarantee of consistency between decisions. If indeed there is an operationally usefill concept of "socio economic benefit", not derived ~om or related to transport user benefits, it needs to be much more clearly expounded, and potentially measurable indicators and forecasting devices for it need to be established.

In arguing that, of course, I am not arguing for a narrow operating cost approach or the maintenance of such simple assumptions as those of a fixed trip matrix. It is clearly the case that major infrastructure developments will affect the decisions of individuals and enterprises in ways which can significantly change not only transport demands but also industrial locations, structures and profitability. The estimation of these restructuring effects is, of course, necessary for the conventional transport user cost benefit analysis. But unless these consequences can be evaluated more easily or more directly than the transport effects, without double counting, they do not necessarily justify moving to a different form of project evaluation.

As the report rightly states on page 20, many environmental impacts can already be incorporated in principle in the CBA format. I am also quite comfortable with the idea of a multi-criterion appraisal. But as it stands I have the uneasy feeling that what is being offered as a criterion is an empty box with no operational content. For example, filling in the "missing links" to secure regional integration could be stated as an objective and a simple plus or minus value attached to projects for this dimension. But I would be very suspicious indeed that it had no real meaning unless we could define the meaning of regional integration much more precisely and be able to both forecast ex ante and check ex post on the extent to which a project the extent to which the objective had been furthered. I feel that the report should make this more explicit.

1.5.3. Dynamic development effects and their relationship to the appraisal criterion

The report states that the conventional cost benefit analysis understates the true benefits of transport infrastructure investments. It gives little evidence in support ofthat position. For instance, insofar as road investments assist traffic which has detrimental effects on the environment, and environmental effects are amongst those left out of the traditional analysis, there will be an over-estimation rather than an underestimation of benefit.

There is of course some suggestion in support of this proposition at the macro level arising from the work of Aschauer. But that work has tended to be very aggregate, and not to discriminate well between different types of infrastructure. It has been subject to much criticism. But it might be worth looking at that literature, and the ongoing work of Bennathon and Hulten which is attempting to apply it at a more disaggregate level to types of infrastructure.

At the micro level of analysis there is a distinct feeling of deja vu in reviewing this aspect of the study. In the late 1960's I undertook a study ofthe likely effects ofthe M62 motorway connecting Hull and Manchester. In the terms used in COST 317 it would certainly have been considered as a missing link. One of the aims of that study was to examine whether the traditional cost benefit analysis, as then beginning to be applied to road schemes in the United Kingdom, would fail to properly capture the main benefits of such a major scheme.

As part of that work I reviewed the previous theoretical studies in the field, including the seminal papers by Bos and Koyck, Tinbergen and Friedlander. In an article in the journal Regional Studies I set out my own views of the issue. It seemed to me that most of the structural adjustments which might result from the introduction of a major new link would only generate economic benefits insofar as it affected transport patterns. In a perfectly adjusted competitive market in the absence of economies of scale there would be adjustments in industrial and market locations. If factors were also in perfectly elastic supply the net increment of national income resulting from an ullcharged for infrastructure improvement would, I concluded, be well indicated by the transport user benefits as measured (including changes both in time and money costs of operation of vehicles). I would very much like to see some empirical demonstration that that judgement was substantially wrong.

Of course that did not solve any practical problem. It meant that the correct measurement of benefit through the CBA was still dependent on accurately forecasting the traffic effects. And, of course, the correct forecasting of the traffic effects depended on accurately forecasting the industrial restructuring effects. This in its tum depended on knowledge of the various determining parameters such as the factor supply elasticities, scale economy characteristics, etc. And those, of course were what we did not know.

Since then there have been various thrusts of research which, if successful, might have filled the missing link in the analysis. The problems of giving a spatial dimension to input output analysis have been addressed in principle; but the problems of heterogeneity of outputs and inputs, and of the dynamics oftechnological progress, have limited the practical application ofthis forecasting tool. The major development which seems to me to be-of significance in this respect is the MEPLAN kind of model which operates on land rents and through that mechanism feeds back to land use. The treatment of MEPLAN in the report seems to me to be rather harsh. Not only does it criticise MEPLAN for not succeeding in doing things that othershave not even come close to achieving, but it also makes judgements on the forecasts of MEPLAN in connection with the Channel Tunnel (for example, the assertion in 2.7.3 that it overestimates the effect in peripheral regions and underestimates the effests in central regions) that cannot yet be empirically verified, and have no apparent basis in any similarly scientific alternative forecasting instrument. The suggestion that we might improve the modelling of structural effects by "backcasting" exercises, in which the consistency of observed developments with a model forecast is tested, seems to me to be very apposite.

In summary I am much less sanguine about developments in this direction, which says that "practices in the evaluation of socio-economic effects are still developing".My reading of the reviews of project evaluations in the interim report is that we have not made much progress since 1970 on the empirical front, and may have actually regressed on the theoretical front by forgetting, or disregarding, the basic microeconic analysis..

1.5.4. Objectives and the implications for appraisal

Section 3.4.1 ofthe report rightly points out that if the goal of policy is to secure redistribution, are distributive element has to be included in the decision process. But it does not go on to give any very concrete suggestion as to how this should be done.

I also have a sense of deja vu on this regional impact front. At about the same time that I was worrying about the M62 my colleague Professor Arthur Brown was involved with a government committee of inquiry - the Hunt Committee - which was concerned about the appropriate policies to pursue in an attempt to reinvigorate some of the moderately depressed areas in the UK, then called the "grey areas". In a minority opinion (a minority primarily because his colleagues were not such good economists as he) Brown doubted the efficacy of transport infrastructure investment alone to stimulate the depressed areas. The essence of that issue is that transport costs act like tariffs in international trade. A mutual reduction oftariffs simply increases the potential market area ofthe lower cost producer at the expense of that of the higher cost producer of any product. Road infrastructure investments are likely to have the same effect. Only in the case where it is possible to restrict access to the network in one direction or another, or to manipulate the tariff structure (for example to reduce the cost of raw material inputs to and product outputs from the less efficient production area and vice versa for more efficient production locations) can one have any confidence that transport infrastructure cost reductions will reduce regional disparities in activity levels.

That conclusion is, of course, essentially parallel to the conclusion in the interim report that efforts to reduce the burdens of peripherality usually need to be packages comprising both transport costy reductions and other measures to reduce production costs in the peripheral regions. The need for "back-up" policies is well expounded in section 3.3 of the report. Outside the boundaries of such a comprehensive package burning the bridges may in fact do more to protect the depressed regions than building them, especially if there is no adequate "trickle down" mechanism to redictribute the benefits of improved efficiency within a national (or more importantly Community) space.

If it really is the case that transport infrastructure investment, on its own account, does not necessarily help less developed regions, a secondary question then arises. In such circumstances what are the relative effectiveness of the component parts ofthe package. If the fundamental objective is to reduce peripherality than transport improvement is only one ofthe possible instruments, and must be appraised in comparison with other elements of the package. It may be the case that transport infrastructure investments are not a particularly effective component. The need for a cost benefit analysis of alternative policies remains.

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1.6. Comments by Mr. Rico Maggi,

1.6.1. Preamble

What can a single "expert" - and an outsider - contribute to the work of a group of leading experts who have thought on an issue for several years ? He can try to take advantage of his limited horizon to put forward some simple ideas and confront them with the highly complex arguments of the group. That is what I'm trying to do here. But before presenting a brief sketch of my critical arguments I want to state that the work done so far is a big achievement as such. It has brought up a high density comparative overview on research on the chosen topic in Europe.

1.6.2. The (re-defined) Objectives of COST 317

Initially, the action set out to identify appropriate evaluation methods for the socio-economic impacts of large scale infrastructure projects using the Channel tunnel as an example (as a laboratory).

They have gradually found out that reality is complex, that there exist many methods which are not easily comparable, and there are other large scale infrastructure projects. It was concluded that instead of looking at one project with one (or few) method(s) one should look at several projects with a multitude of methods.

I doubt whether this was a wise decision for a least two reasons:

¥ If I have the choice either to know a lot about little or to know little about a lot, I prefer the first option. And I do not believe that somehow adding up 5 methods which each are 20% appropriate results in a 100% adequate approach.

¥ Because I think that empirical work is the key to the understanding of the problem (and the report also complains the current concentration on ex-ante evaluations), I do not think that one can gain by adding more of less futuristic projects to a real one.

If I understand correctly, a further aim is some sort of matrix which indicates the appropriateness of different methods for differents contexts (conditions). I wonder whether this can be achieved, given that the group does not believe in the relevance of any single approach. As a consequence, I prefer the initial objectives to the re-defined ones. If one has to be more humble, and I think there is reason for that, I would propose to scale the objectives down in a different way. It seems more appropriate to identify promising research strategies for understanding rather than tools for evaluation of the impacts of the Channel tunnel .

1.6.3. Nature of Effects, Evaluation in Theory and Practise

The two main parts of the report leave very little chance for criticism in detail. The work is impressively broad and the arguments, especially in the first part are well organised. I agree with most of what is said in this part and I take notice of the vast amount of work that has been reviewed for the second part.

What I miss is a weighting of the material presented and some choices which would define a COST 317 philosophy. Does the sum of southern complexity and northern rigidity really produce a unified European approach to the problem? I do not think so.

1.6.4. What now?

As I indicated at the outset, my proposals are rather simple. I take for granted that if the aim is to come up with some instruments of general relevance we have to identify research tools which allow to draw some general conclusion from studying some specific project. Hence, traditional case studies will never do the job. They can be used only in either a preparatory phase (to have a feeling of the context in which the modelling is undertaken) or in a final phase in order to embed the results in a concrete context.

Hence, I opt for serious modeling - econometric modeling as far as my own expertise is concerned. Because I agree that there is no single valid method of evaluation (give me a ficed point in the Universe...), I want to propose some elements of a research strategy which promises to separate obviously distinct effects of an infrastructure from within the complex spatial interactions in which it is embedded.

A first strategy one might think of is aggregate modelling. This might be undertaken in any of the forms mentioned in the report, like e.g. regional growth models, spatial interaction models, simultaneous models of development and infrastructure etc.. The advantage of these models is that they take for granted that you have to deal with spatial processes and regional development before you can model transport infrastructure impacts. On the other hand, the relevance of the outcomes is limited by the relevance of the models in explaining regiohnal development.

In the present context I would not opt for aggregate modelling of this type for two reasons :

¥ These models are too much concentrated on the infrastructure as such and neglect the things that happen in terms of users of the infrastructure.

¥ Because the task is to analyse effects of large scale projects cross-sectional approaches are doomed to fail due to lack of cases. And the transfer of results from modelling in a small scale context is problematic. On the other hand, longitudinal analysis is difficult because the project is either very recent, and hence impacts cannot yet be measured, or the project has been realised long ago and hence the context is quite different.

Given the arguments so far, I have to end-up with proposing disaggregate modelling. And I do think that it would be the most relevant thing to undertake regarding the Channel tunnel. The effects of this large scale infrastructure lie entirely in its use. If we can find out what changes in behaviour of users have been brought about by the opening of the tunnel, we can start wondering aboutthe impacts. I do not talk about assigning traffic flows. I mean modelling in three domains:

¥ demand side behaviour : individuals and firms (shippers) and their transport demand behaviour embedded in the case of households in activity schedules, and in the case of firms in logistics strategies ; supply side behaviour : carriers and their supply strategies in terms of prices and quality in response to demand ;

¥ political behaviour : supply and demand of regulation promoting or hindering the use of the channel tunnel as a function of the interests involved.

I think that the last step into political economy is decisive for making some good guess about future developments. And it seems as if the authors of the report had some similar ideas when referring to societal complexity.

The remaining task for COST 317 in this framework would then be :

¥ first, to sort out those research tools in the three domains which in the view of the experts involved seem to be most promising ones ;

¥ second, to design a strategy of how to combine the tools from each of the three domains ;

¥ third, to give some preliminary evidence for the case of the Channel tunnel.

Zurich, September 27,1995

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1.7. Comments by M. Dominique Schwartz

1.7.1. Remarque liminaire :

L'action COST 317 a ŽtŽ lancŽe en 1991 et je ne l'ai personnellement pas suivie, jusqu'ˆ la proposition qui m'a ŽtŽ faite en aožt 1995, de participer ˆ un sŽminaire sur les thmes qu'elle traite et de rŽdiger une courte note ˆ propos du rapport intermŽdiaire de fŽvrier 1995. Prenant ainsi en quelque sorte " le train en marche ", il est plus que vraisemblable que les observations qui suivent ont dŽjˆ ŽtŽ formulŽes lors des rencontres des experts participant au comitŽ de gestion de l'action et qu'elles ont pu tre ŽcartŽes ˆ la suite d'un travail de groupe et de la confrontation de rŽflexions plus profondes et d'expŽriences plus vastes que les miennes.

L'objet initial de l'Žtude, rŽsumŽ dans le nom que porte encore l'action COST 317 (les effets socio-Žconomiques du Tunnel sous la Manche), peut para”tre ˆ priori na•f et rŽducteur : s'agirait-il d'une Žtude supplŽmentaire partant du postulat que les infrastructures de transport ont une influence forte qu'il est possible d'isoler dans le concert des multiples actions interactions, rŽtroactions qui agitent les sociŽtŽs humaines et que cette influence peut tre prŽvue avant et mesurŽe aprs la rŽalisation des dites infrastructures ? Trs vite, la lecture des premires pages du rapport intermŽdiaire rassure : le champ de l'Žtude a ŽtŽ considŽrablement Žlargi : elle portera sur tous les projets d'infrastructure de transport importants au niveau europŽen, sera essentiellement mŽthodologique, critique et devra se pencher sur l'analyse du fonctionnement social.

Le rapport datŽ de fŽvrier 1995 est d'une grande qualitŽ : sa rŽdaction particulirement claire met en relief les points essentiels des pratiques actuelles : ˆ propos de nombreux projets et de multiples Žtudes, les mŽthodes employŽes et les donnŽes rŽunies sont dŽcrites de manire synthŽtique, ainsi que les problmes rŽsolus et les questions restant posŽes.

Deux remarques s'imposent : d'abord, la troisime direction proposŽe ci-dessus, la nŽcessitŽ d'une analyse du fonctionnement social est moins dŽveloppŽe que les autres, ensuite, l'aspect " critique " de l'analyse mŽthodologique est somme toute assez timide. Les observations qui suivent pourront sans doute tre jugŽes excessives en sens inverse, dans la mesure o elle rŽagissent ˆ une position naturelle, s'agissant d'un rapport de travail d'Žquipe, donc nŽcessairement de compromis.

1.7.2. A la recherche d'une norme

L'introduction du rapport dŽcrit fort bien le contexte des travaux et cite mme (page 9) un texte ayant servi de base aux travaux du groupe et lui assignant comme objectif de mieux conna”tre les " effets structurants " des infrastructures de transport. On retrouve ensuite, a et lˆ, dans le texte, des regrets que telles approches telles mŽthodes, tels rŽsultats, ne soient que trs difficilement comparables, ou gŽnŽralisables.

Il semble bien que l'un des buts, explicites ou implicites, de la commission qui a mis en place le groupe de travail ait ŽtŽ la qute d'une impossible norme, qui aurait pu permettre de rŽdiger une impossible directive, sur la mŽthode ˆ utiliser, dans tous les cas, pour rŽsoudre un problme d'Žvaluation ˆ l'Žvidence difficile. Mais le problme est-il bien posŽ ? Les expŽriences qui sont rŽsumŽes ensuite semblent bien Žtablir le contraire. L'introduction se cl™t alors, ˆ juste titre me semble-t-il, sur la constatation de l'impossibilitŽ de faire Žmerger des travaux du groupe COST 317 une mŽthode unique, universelle.

Cette observation fondamentale est le fil conducteur de la premire partie du rapport, qui tente cependant de rŽpondre le mieux possible ˆ la question posŽe, mme si cette dernire n'est pas raisonnable.

La conclusion de cette partie est qu'il faut surtout travailler de faon empirique et continuer ˆ chercher ˆ " rendre les comportements d'Žvaluation comparables ". Dans le cadre rappelŽ plus haut, on ne peut qu'adhŽrer ˆ une telle conclusion, mais il faudrait sans doute l'assortir de la nŽcessitŽ de donner un meilleur fondement thŽorique ˆ ces travaux, ˆ l'intŽrieur de ce qu'il est convenu d'appeler l'Žconomie gŽographique, ou la thŽorie de la localisation. C'est en fait ˆ un niveau plus conceptuel, pour ne pas dire thŽorique que pourrait s'effectuer une comparaison entre plusieurs pratiques d'Žvaluation et sans doute pas au niveau des types de donnŽes rŽunies ou des types d'effets apparemment observŽs : l'observation empirique enrichit ou contribue ˆ invalider un modle thŽorique sous-jacent qu'il vaut toujours mieux tenter d'expliciter et de prŽciser le mieux possible.

Au delˆ de la nŽcessitŽ de mener, dans ce domaine comme dans d'autres, des travaux de recherche thŽoriques permettant de fonder des observations empiriques, on peut aussi souligner le caractre artificiel des rapports qui sont suggŽrŽs dans le dŽbut du texte entre les instances d'Žtudes et les pouvoirs de dŽcision.

1.7.3. Le mythe de l'Žconomiste et du dŽcideur

Le texte de l'introduction est trs explicite ˆ cet Žgard et cite les " pressions " exercŽes par les instances politiques sur les Žconomistes en charge de mener l'Žvaluation d'un effet dont l'existence est postulŽe. Il ne saurait tre question de nier l'existence de ces pressions, qui existent depuis toujours et dont on ne voit pas bien comment elles pourraient dispara”tre. Elles sont mme si pernicieuses qu'elles jettent le discrŽdit sur de nombreuses Žtudes.

Trois exemples rŽcents, en France, mŽritent notre attention : le Tunnel sous la Manche, la liaison OrlyVal, le Tunnel Prado-CarŽnage. Il s'agit, dans les trois cas, de projets privŽs et pourtant, les pressions politiques ont ŽtŽ trs fortes et se sont exercŽes depuis un niveau national voire international pour le premier, national (ministŽriel) pour le second, local pour le dernier. Des Žtudes Žconomiques ont ŽtŽ effectuŽes, pour prŽvoir les trafics, les recettes et Žvaluer les rentabilitŽs financires de ces projets. Sans revenir sur les difficultŽs rencontrŽes par le premier, on peut souligner que le trafic d'OrlyVal Žtait infŽrieur des deux tiers aux prŽvisions et que celui du tunnel routier urbain dit Prado-CarŽnage ˆ Marseille l'Žtait de moitiŽ.

Quand il s'agit de l'argent des contribuables, les projets publics connaissent parfois un sort comparable, mais moins visible, car nulle faillite ne pointe ˆ l'horizon, nul petit actionnaire ne se plaint d'avoir ŽtŽ spoliŽ. Mais l'autoroute A4 n'avait toujours pas, vingt ans aprs son inauguration, le trafic qu'on disait attendre ˆ l'ouverture.

Dans un article cŽlbre, Claude Henry (la micro-Žconomie comme langage et enjeu de nŽgociations - 1984) expose comment la micro-Žconomie (rigoureuse Žvidemment) peut tre un bon langage de contestation publique, en mme temps qu'un instrument d'organisation des rapports entre divers acteurs publics. En d'autres termes, les Žtudes technocratiques Žtant susceptibles d'tre manipulŽes, il importe d'introduire de la transparence dans le dŽbat qui doit s'instaurer avec les contre-pouvoirs. C'est aussi tout le sens de la " circulaire Bianco " de dŽcembre 1992 sur les choix d'infrastructure en France.

Mais encore faut-il que la thŽorie Žconomique appliquŽe aux transports possde un niveau suffisant de rigueur et surtout que les Žconomistes - ou ceux qui se disent tels - qui mettent en oeuvre les modles usuels en connaissent les limites, et en ma”trisent tous les concepts. Or l'expŽrience montre ˆ l'Žvidence que c'est loin d'tre le cas et ˆ cet Žgard, les trs intŽressantes fiches rŽsumŽes des " pratiques actuelles d'Žvaluation " de la deuxime partie du rapport sont d'une grande indulgence vis-ˆ-vis de travaux parfois d'une indŽcente mŽdiocritŽ.

La plupart des modles utilisŽs partent de l'idŽe qu'un investissement d'infrastructure conduit ˆ une baisse des cožts de transports et apporte un avantage aux usagers ou un avantage comparatif aux zones desservies. Le pionnier du premier aspect est Jules Dupuit (1844), le dŽfricheur du second est Johann von ThŸnen (1826).

1.7.4. L'hŽritage de Dupuit

Jules Dupuit a introduit le concept de surplus Žconomique, qui a servi de base aux travaux ultŽrieurs sur l'Žvaluation de l'intŽrt public des projets, lesquels procdent par " agrŽgation des surplus ". Cette agrŽgation n'est valide que sous l'hypothse d'une utilitŽ marginale du revenu Žgale pour tous, c'est-ˆ-dire de rŽpartition optimale des revenus, trs loin de la rŽalitŽ. Il ne s'agit pas ici de contester la validitŽ du cadre nŽoclassique de ces Žvaluations, mais plut™t de souligner les prŽcautions nŽcessaires ˆ l'utilisation d'un modle particulier quand bien mme l'agrŽgation des surplus serait lŽgitime - ce qui est loin d'tre le cas - le fameux " bilan Žconomique actualisŽ " procde ˆ des sommes algŽbriques et sa positivitŽ peut masquer des nŽgativitŽs locales parfois insupportables.

A propos de l'analyse cožt-avantages appliquŽe ˆ l'Žvaluation des autoroutes urbaines, P.A. Sammelson disait dŽjˆ (dans Economics) : " le programme autoroutier semble distribuer dans les zones urbaines, les avantages de faon croissante et les cožts de faon dŽcroissante ", les zones urbaines denses proches des centres villes n'ayant souvent rien ˆ gagner en termes de dŽplacements ˆ l'existence d'une autoroute nouvelle et y trouvant mme parfois une croissance de la congestion ou une consommation excessive de sols. Cela conduit aussi au constat, encore plus nŽcessaire aujourd'hui, de l'insuffisante prise en compte des externalitŽs nŽgatives dues aux transports dans les analyses cožt-avantages.

Un exemple, trs rŽcent, illustrera la difficultŽ d'Žvaluation des " consŽquences " de la mise en service d'une infrastructure. Reprenons le cas de la mise ˆ deux fois deux voies de la RN 137 qui relie la ville de Rennes ˆ la " c™te d'Žmeraude " (Saint-Malo, Dinard, Saint-Lunaire, Saint-Briac...) dans le cadre du " Plan Routier Breton ". L'analyse des flux routiers montre une nette augmentation du trafic sur cette route, surtout pendant la pŽriode estivale. Faut-il en dŽduire, comme on nous y invite, ˆ un " essor du tourisme " ? La rŽalitŽ est tout autre, comme l'Žtablit facilement une analyse plus fine ; les faits sont les suivants : les stations balnŽaires citŽes ci-dessus ont vu, pendant l'ŽtŽ, leur rues envahies de vŽhicules, rendant, ˆ certaines heures, la circulation et le stationnement impossibles; en revanche, les commerants ont vu baisser leur clientle, les agences immobilires Žgalement (de nombreuses villas et de nombreux appartements sont restŽs vides), certains restaurants et mme les terrains de camping, qui n'ont pas, de loin, " fait le plein ". L'explication est simple : l'amŽlioration de la sŽcuritŽ sur cette route auparavant rŽputŽe trs dangereuse et la forte diminution du temps de transport entre Rennes et la c™te ont permis aux rennais de pouvoir profiter des infrastructures touristiques tout en continuant ˆ vivre ˆ Rennes et en faisant l'aller-retour quotidiennement.

Comment faire le bilan de la situation pour cette annŽe ? Les vacanciers-automobilistes ont vu leur surplus s'accro”tre, mais certainement pas les vacanciers-rŽsidents (invasions des voiries mais aussi des plages, devenant ˆ midi terrains de pique-nique), ni les " professionnels du tourisme ".

Mais il faut aussi s'interroger sur la nature du phŽnomne observŽ : tendance ou conjoncture ? quelle est la " part " de la basse conjoncture Žconomique et sociale dans le comportement " Žconome " des touristes rennais? Une telle situation est-elle susceptible de perdurer ? Comment la relier au contexte macro-Žconomique exogne ? Et si elle perdure, quels vont tre les consŽquences ˆ moyen-long terme sur les activitŽs locales ?

L' accessibilitŽ de la rŽgion de Saint-Malo a ŽtŽ amŽliorŽe, mais on voit bien que le passionnant concept d'accessibilitŽ, si riche et si divers, demande ici ˆ tre prŽcisŽ, ˆ un niveau Žventuellement trs fin.

1.7.5. L'hŽritage de von ThŸnen

A c™tŽ des modles micro-Žconomiques reposant sur une fonction d'utilitŽ dans laquelle interviennent les cožt et temps de transports, on utilise aussi des modles de caractre macro-Žconomique, qui cherchent ˆ relier les variations des cožts de transports ˆ des phŽnomnes de localisation des activitŽs dans l'espace et, partant, ˆ des modifications de la production ou de la productivitŽ. Ces travaux font un grand usage des techniques de l'ŽconomŽtrie, dont on sait bien que la ma”trise demande un certain talent.

A c™tŽ d'Žtudes menŽes avec une insuffisance de rigueur manifeste, on retiendra deux exemples.

Le premier est la cŽlbre Žtude de J.R. Meyer, reposant sur des modles de simulation de l'Žconomie colombienne, en 1971, conduisant ˆ la conclusion que l'effet d'une augmentation gŽnŽralisŽe de la capacitŽ de tous les rŽseaux de transport du pays, ne conduit qu'ˆ une croissance Žconomique de 2 % en 10 ans (l'effet de l'amŽlioration des transports sur la composition de la production au niveau des rŽgions ou des secteurs industriels Žtant en revanche trs sensible).

Le second est beaucoup plus rŽcent (1994), il est dž ˆ Moomaw, Mullen et Williams (The inter-rŽgional impact of infrastructure capital). Il montre clairement, ˆ partir d'une fonction de production translog, que si le capital public accumulŽ a une contribution positive ˆ la croissance de la production et de la productivitŽ des Etats amŽricains, les rŽseaux d'approvisionnement en eau et les rŽseaux d'assainissement y jouent en fait un r™le beaucoup plus important que les rŽseaux autoroutiers (c'est trs sensible dans les Žtats du sud des Etats-Unis). Il met en Žvidence en outre un intŽressant phŽnomne de saturation de l'influence du capital public sur la croissance, dans les Žtats trs ŽquipŽs du nord-est des Etats-Unis.

Une dernire remarque semble importante, ˆ propos de la notion de " maillon manquant ".

1.7.6. Un concept flou et dangereux : le maillon manquant

Le rapport fait usage de la notion, apparemment simple et naturelle de "maillon manquant", introduit dans les arcanes de la CEE en 1984 par un lobby notoire : la table ronde des industriels europŽens. L'apparence est le simple bon sens : il existe des goulets d'Žtranglement en termes de trafics et il faut les supprimer pour dŽvelopper les trafics et contribuer ˆ une meilleure " articulation physique des Žconomies europŽennes ".

La rŽalitŽ est cependant loin de cette vision simpliste qui, encore une fois, repose sur le postulat que l'accroissement de capacitŽ soit l'investissement en infrastructures de transport a nŽcessairement des consŽquences fastes sur les rŽgions reliŽes, sans regarder de trop prs les rŽgions traversŽes ni les rŽgions tierces. On sait bien que, mme en ce qui concerne les rŽgions d'origine et de destination des fameux maillons, c'est faux. Les spŽcialistes de thŽorie des jeux n'ont par exemple, aucune difficultŽ ˆ construire des exemples simples de graphes ˆ

quelques arcs, reprŽsentant des flux de transport fonctionnant efficacement et tels que l'adjonction d'un maillon supplŽmentaire prŽcipite l'ensemble dans l'inefficacitŽ.

Le concept de " maillon manquant " a aussi une dimension simplement gŽographique, voir gŽomŽtrique ou topologique: il s'agit alors simplement d'ajouter une ligne sur une carte ou sur un graphe o elle semble " manquer ". La lŽgretŽ du point de dŽpart ne fait pas obstacle ˆ la vigueur de la pression qui ne manquera pas de s'exercer pour la rŽalisation de l'infrastructure en question. En France, certaines " autoroutes des estuaires ", le T.G.V. limousin, font partie de tels projets. D'une manire plus prŽcise, certains maillons rŽputŽs manquants du rŽseau autoroutier franais ont ŽtŽ rŽalisŽs et supportent un trafic si faible qu'on s'interroge vraiment sur leur caractre nŽcessaire. Il en va clairement de mme pour la mise ˆ grand gabarit de la liaison fluviale Rhin-Rh™ne, dont l'intŽrt Žconomique semble bien se limiter aux effets KeynŽsiens de court terme pendant la pŽriode de construction et qui, porteur de l'Žtiquette " maillon manquant " est en passe d'tre rŽalisŽe, aux frais des consommateurs franais d'ŽlectricitŽ.

Paris, le 18 septembre 1995

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1.8. Comments by Professor Dr. Eddy Van de Voorde

THE INTERACTION BETWEEN SCIENCE, POLITICS AND INVESTMENTS

1.8.1. A few thoughts about a study on the socio-economic effects of the Chunnel

First of all, I wish to express my appreciation of the work done so far. Indeed, the work had to be done under extremely difficult circumstances. The participation of and cooperation with experts from so many countries is not self-evident. The present report comprises a good theoretical foundation, and especially an interesting survey of a number of existing studies, the methods they used, indicators, results and weak points.

At the same time, I wish to express my appreciation of the initiators of this scientific confrontation in Tramelan. The time seems ripe to have a discussion about the state of affairs of the activities realised so far, and possibly to formulate proposals for adjustments. Personally, I am more interested in formulating a number of general options than in summing up detailed criticism.

1.8.2. general options

1. COST 317 grew out of COST 312. In spite of the fact that there were also clearly political and philosophical differences, COST 312 remained mostly focused on statistical work. And it is precisely the statistical work that is important. This is why the following question needs to be asked indeed: to what extent did the (un)availability of data determine the research activities ? This is a crucial problem, certainly where economic modelling is concerned. Perhaps this is the moment then to determine, without or without Eurostat's cooperation, which data will be needed in the future and how they can be collected and made available on a continual basis.

2. It is rightfully stated that 'owing to the variety of authors they make no claim to unity in style or perfect consistency in analysis. However, the ensuing question is then : did the ÇÊdiversity of approaches and variety of cultureÊÈ also effectively lead to scientific progress? This is partially related to the statement that 'these methods and current practices are a long way from being permanently fixed ; they are still developing today. The question then remains whether from a scientific point of view there is a concurrent evolution (e.g. on the methodological level). If this is not the case, it needs to be investigated to what extent this is due to the totally different character of the infrastructure compared, and / or to the totally different character of the circumstantial factors (e.g. the supporting policy of regional authorities).

3. The present study justifiably builds on existing, mostly published literature. However, it is also important to look at current on-going studies, projects that have not necessarily led to publications yet. Two examples will illustrate this. There is an on-going study of a research team headed by professor C. Ru~grock (Catholic University of Tilburg, the Netherlands), and this study is aimed at the analysis of possible effects of structural ruptures, a so-called "strategic exploration". This concerns a model in the very long term, say towards the year 2040. Then there is also the brainstorming going on in Belgium, concerning what is called 'sustained mobility'.

4. The present report puts forward four objectives: the inventory of databases, the identification of variables, new databases, and a methodological learning process. Yet in my view, what is also needed here is an inventory of all scientific work that can be a direct or indirect input for COST 317. A typical example here is certainly the work done on the

appreciation of the time factor. It is precisely the time factor that strongly influences the evolution of the generalised cost, and as such the behaviour of passengers and the goods shippers.

5. An important distinction is made between the direct and indirect effects of new, and large transport infrastructure. It is also rightfully said that the effects are not immediately visible and attributable. But too little importance is attached to the time span. Even if there are effects with a time lag, and there are possible influences of other operations, a comparative study over the time span could provide the researchers with a great deal of information.

6. The role of 'political decision-makers' is probably theoretically correct, but in practice the situation is often different. In this report the authors say that they look at the following three elements : build infrastructure or not ? which technical solution? what are the effects on the regions and their activities ?

Yet there are also so-called 'hidden agendas', often linked to industrial objectives. The Dutch decision to construct the Betuwe line (a railroad link between the port of Rotterdam and the German hinterland) after all, clearly has other objectives. Nearly every preparatory study (for instance cost/benefit analyses) have pointed at important problems. Yet the construction was decided anyway.

The Dutch authorities' political decision in fact came down to the following :

- they wanted to invest at no matter what cost, preferably with European support (cfr. TEN), and in spite of important, demonstrably negative effects (e.g. for the environment)Ê;
- they also wanted to give the port of Rotterdam a weapon in its competitive struggle with other European ports in the Hamburg-Le Havre range ;
- they hoped that a number of important, especially industrial side effects will be generatedÊ; the specific nature of the investment (focused on goods, the necessity of a great deal of tunnelling work etc.) gives the Dutch construction sector a competitive edge in terms of know-how that is experienced as important ; in a next stage this has flow-back effects on the exportÊ; this strategy is comparable to what happened in the past with the Dutch (and Belgian) dredging sector.

Industrial objectives underlying infrastructure and the transport sector are not new of course. In the past as well, this tactic has been used extensively. In Belgium many decisions on railroad infrastructure-and operations used to be less inspired by the interests of the railroad company, NMBS/SNCB, than by the interests of constructors such as Brugeoise et Nivelles (BN, now Bombardier) and ACEC-Charleroi.

7. The determination of the projects of the European Union (Corfou and Essen, 1994) was clearly a purely political decision : give every member state at least one project, so that they keep quiet. Scientifically this is nonsense. The justification given is often a forced one (cfr. cohesion fund).

It is said that a number of projects can be subsumed under guaranteed financing in a cooperative relation between thepublic and private sector. For the High-Speed Train project on the lines of Brussels-Amsterdam and Brussels-Cologne, and also for the Betuwe line, I have serious doubts about the interest shown by the private sector (certainly if no state guarantee is given), because the low profitability of these projects is nearly certain.

8. On page 47 this report refers to the most important missing links in Europe. Reference is made to an NVI study from 1982. Yet a few questions could be asked here: to what extent has the transport market evolved? Haven't alternatives been developed in the mean time? Haven't/ circumstantial factors changed?

9. As far as the network for combined transport is concerned, it should be realised that in the mean time, many separate initiatives have been taken. Admittedly, every separate decision to invest has, on the other hand, an effect on the total transport network and its profitability.

10. In the methodological field, the present report often refers to economic approaches and empirical methods. Yet it should be clear that every methodology should take account of the fact that this kind of new and sizeable infrastructure building results in structural rupturesÊ: the trend from the past, if it was there at all, is no longer valid. We have to realise that the estimated coefficients from the empirical work within the classical methodology can only be used within a certain range. For actions that change the structure of transport itself another, more dynamic methodology is needed.~That is why it is important to have an eye for the current research in this field (cfr. the above-mentioned reference to professor Ruygrock).

11. There are indeed few a posteriori studies. The authors rightfully state that for a decision maker and his financiers a priori studies matter most, because they are at the foundation of their eventual go/no go decision. Yet here we have to reflect for a moment.

There is a growing tendency to also evaluate the investment decisions a posteriori. The Flemish Port Commission has prepared a proposal to follow up every important investment for its results in the future. Port authorities formulate forecasts to support for instance cost-benefit analyses. With positive results they get subsidies for their investment. The present proposal now comes down to penalising ports that do not live up to their forecasts by having them pay back part of the investment support. The incentive to play foul a priori and to influence the studies will doubtlessly become smaller.

Of course, nothing prevents us from doing a number of a posteriori studies ourselves within the framework of COST 317, and from doing this according to a certain imposed pattern. This requires a decision to carry out research collectively, a decision that has to be taken on the European level, yet including, also the financial and organisational commitment.

12. Personally, I wholly agree with the statement that 'it does not seem realistic to try to establish a single method'. It is true that one should be aware of the various methods that are about, and that one should particularly look at their applicability. So here I dare to plead for a widening of the research field. Let us also consider the studies to support the decision to construct the second bridge across the river Tagus in Lisbon (1994). There as well, were not enough data and no immediately suitable methodology. Yet this led to an innovative approach.

13. Even getting a better understanding of the methods used gives researchers and policy makers the opportunity to mark out further action. It may be considered as the equivalent to working, within the traditional and modelbound methodology, with different scenarios and a sensitivity analysis. Drawing up an inventory of possible effects is not really a problem (cf. Rietveld), but separating those effects and especially measuring the importance of each of the influencing variables is.

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1.9. Comments by Professor Roger Vickerman,

1.9.1. Introduction

The report represents an attempt to synthetise a range of approaches to the problem of identifying and estimating the impacts of major transport infrastructures on social and economic indicators in affected regions. The variety of these approaches is well represented, the problem now faced is whether it is possible to.effect a synthesis and recomrnend a single approach relevant to a specific infrastructure, in this case the Channel Tunnel. This Cornment is structured in three parts. First, we consider gaps in the methodologies reviewed. Secondly, we offer some comment on the evaluation provided. Thirdly, we present some suggestions for future work.

1.9.2. Review or methodology

The Report starts with the premise that a variety of methods has arisen due to the lack of precision from any one method and the often politically driven nature of many studies. Since they are, by their nature, large studies, they are typically undertaken only by bodies with a vested interest in the answer. An exceptlon to this would be the study of the Channel Tunnel for DGXVI, reported in Part 11, section 2.7. Three issues are raised here, the use of econometric studies, the absence of discussion of UK studies of the Channel Tunnel, and the problem of discontinuities in networks.

1.9.2.1. Econometric Studies

Econometric studios have not typically been used to assess the impacts of specific projects ex ante, but have been used in ex post studies of the differentials in regional economic performance associated with differences in regional provision of infrastructure. Such work has either concentrated on the aggregate production function approach pioneered by Aschauer (1989, 1990) and Munnell (1990, 1992), where infrastructure is measured in terms of the size of investment, or a surrogate production form which can be traced through the work of Blum (l982), Biehl (1986, 1991), Fritsch and Prud'honune (1994), Llanos (1995), and see reviews by Rietveld and Nijkamp (1993), Vickerman (1994b) and Gramlich (l994). Although there is considerable contronversy surrounding both the measurement issues (how should regional infrastructure provision be measured, and how should different types of infrastructure be aggregated, how valid is it to use investment when prices are often distorted by public sector provision) and the econometncs of estimation (especially in studies which aim to estimate an efficiency parameter - the productivity of public infrastructure) these differing approaches all provide some insight. The critical step is to measure a sufficiently stable relationship to be able to use this approach in the ex ante evaluation of single projects.

1.9.2.2 UK Channel Tunnel Studies

Given the private sector status of thc Eurotunnel project thc UK government believed it was inappropriate to conduct any official overall cost-benefit analyses. Nevertheless, prior to the decision to invite bids there had been official studies which provide an interesting baseline for subsequent work. These go back to the major studies conducted in connection with the 1970s project, first by Coopers and Lybrand (Department of the Environment, 1973) and subsequently by the Channel Tunnel Advisory Group (Department of the Environment, 1975) which was published just after the decision to abandon the project. These included comprehensive assessments of the transport impacts of the project, including the important impacts on the competing ferry services. The 1975 report investigated the inter-relationship between the return on the tunnel project and that on the associated high-speed railway line. Following this was the important analysis of the Anglo-French Study Group, published in 1982, which laid the basis for the decision to proceed taken in 1985 (Department of Transport, l982). Such studies had been conducted for some ear1ier major projects in the UK, such as the first Severn Bridge (Cleary and Thomas, 1972). Reference could also be made to the development of the official approach to the evaluation of transport projects subject to cost-benefit analysis, principally road projects, which has been scrutinised by a number of reports of the Standind Advisory Committee on Trunk Road Assessment (SACTRA).

Despite the official position there has been a number of local or regional impact studies for the Channel Tunnel for various parts of the UK (see the reviews in Holliday et al, 1991; Vickerman, 1994a). Most significant is that for Kent developed by the Kent Impact Study Team (Channel tunnel Joint Consultative Committee, 1987, 1991). This was concerned not with the decision to construct the tunnel, but to estimate the local impacts, once the decision had been taken. The KIST study developed a sophisticated approach which included both modelling and survey methods to estimate the likely local economic responses and potential migration of firms and workers. This included a detailed attempt to assess the competitive position in the neighbouring region of Nord-Pas de Calais. A key element in the analysis was the impact of tunnel compeition on the ferry industry as a major local source of employment, and its multiplier impact. The 1987 study and the 1991 Review represent important attempts at understanding the process of change through restructuring and relocation of activity following a change in the transport network as opposed to the much more transport flow based 1970s studies.

The KIST studies have been complemented by the Kent Ports Strategy (Kent County Council, 1995) which aimed to assess the impact on both traffic and employrnent from a re-assesment of traffic forecasts. This involved a more detailed modelling of individual routes and alternative competitive responses than had been previously attempted in an independent study of the tunnel, together with the implications for employrnent in the ports. However some smaller scale academic independent analyses of the impacts of alternative competitive reactions had been undertaken (Kay et al 1989, Holliday et al, 1991, Chapter 3, Szymanski, 1994).

1.9.2.3. Network Modelling

Most studies based on gravity type flow relationships assume continuity in networks but imply discontinuous assessments of accessibility in space. There is a smooth response to distance along the network, but regions are assumed to have the same accessibility as their nodal points from which inter-regional relationships are measured. This is clearly not the same, even for regions close to major infrastructures, where local transport may be inadequate (consider, for example, the location of stations served by Eurostar). A recent attempt to model this for high-speed raillinks demonstrates this phenomenon by allowing for continuous space (10 kilometre squares) and access to the networks only at stations served (Vickerman et al, 1995). This contrasts strongly with the concept of the Shrinking Europe highlighted in anl earlier paper (Spiekermann and Wegener, I994) and demonstrates clearly the variations in accessibility even within well served regions and the differential irnpacts of new networks

1.9.3. Evaluation of the Report

Although there are some approaches to evaluation which are under-represented in the Report, the basic conclusion that individual projects require an essentially eclectic approach is one which I would support wholeheartedly. In particular there is a need to bring together modelling and less formal or subjective approaches to evaluiation, through survey and open ended enquiry. Perhaps, however, more thought needs to be given to ways of combining the results of different approaches, how are weighting systems applied, and how sensitive are results to different approaches.

Evidence from various studies connected with the Channel Tunnel suggests that modelling approaches using the basic gravity formulation imply a strong positive impact in regions close to the tunnel with the typical fall-off in impact with distance from the tunnel. Complementary subjective studies suggest a substantial fear of negative effects in nearby regions (which may be strong enough to outweigh the positive impact of potential), but a largely positive attitude in regions at a medium distance from the tunnel (ability to capitalise on advantages without suffering the immediate negative effects. Some of this effect can be introduced through a better incorporation of structural and competitive effects into the gravity based approach, but only up to a point We are left with a problem of weighting potentially contradictory results.

The Report also identifies the problems inherent in using conventional regions to assess impacts. This is partly about identifying the relevant area of impact of a project in order to obtain a complete evaluation, but it is also a more fundamental question affecting the pattern of impact. This relates back to the continuity assumptions referred to in section 1.3. Typically studies tend to use the conventional NUTS-2 regions in the EU due to the need to choose a level at which sufficient data is available These vary enormously in size and function. A functional region such as used by Cheshire (1990, 1995) may offer a better theoretical basis for investigating interegional relationships, but these too will face problems in dealing with the intra-regional disparities which highly discontinuous new transport networks may cause. The essence of much of the development of high-speed rail may be to change the relationships between core and periphery within functional regions due to the strategic selection of station locations.

The Report also makes reference to the need to relate evaluation to the decision making process. This is also a point on which I would agree, but would wish to stress further the difficulty in producing a common evaluation for different task masters, especially different sources of finance. One of the clearest results of the Channel Tunnel case is the apparent impossibility of providing an evaluation procedure which will satisfy the conventional public sector procedures (necessary to obtain governmental approval) and simultaneously meet the frequently changing demands of the private financial sector. This is partly about conÏpts of risk and partly about the type of inforrnation necessary (see the argument developed more fully in Vickerman, 1995a, 1995b).

1.9.4. Future Work

The evaluation presented above identifies clearly the directions in which future work needs to proceed. Following the discussion in Vickerman (1995a) it is recommended that both spatial and sectoral disaggregation is needed in the evaluation of major projects. Both of these disaggregations imply substantial data requirements, but these will be necessary to provide a sufficently flexible evaluation process. This is particularly the case if projects are to be evalualed to meet the needs of different providers of finance, whether from different levels of government, local, regional, national or EU, or from different sources of finance, public, private loan or private equity.

Further work is also required on economic approaches to improve the definition of rneasures of infrastructure as inputs to the production process in order to be able to evaluate more fully the substitutability and complementarity of infrastructure with other elements of the production process This is not a substitute method for the more ad hoc approaches often adopted, but is otfen need to contextualise such approaches. The particular focus for initial work is to separate out more clearly the direct impacts of new construction on local employment and activity from the longer run irnpacts on, first, the productivity and competitiveness of existing firms in a region and, secondly, the movement of productive resources into a region.

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2. Summary of discussions at the Tramelan seminar

By Odile HEDDEBAUT

Having acknowledged the usefulness of a document such as the COSTÊ317 interim report of FebruaryÊ1995, which describes the various methods used in Europe for evaluating transport infrastructures, those taking part in the Tramelan seminar discussed the following two topics. Firstly, whether it was possible for such methods to convey or predict the effects attributable to building such transport infrastructures and, secondly, the difficulties encountered in practice when carrying out evaluations of major transport infrastructures.

2.1 Areas of consensus

Whether members of the COST 317 Management Committee or other invited experts, there was consensus among the participants regarding a large number of points. The first major point of agreement to emerge was that the effects of transport infrastructures were not automatic. This was tantamount to rejecting the use in isolation and hence the effectiveness of models which make use of Keynesian-style investment multipliers which automatically spread throughout the entire economy of the area under consideration.

The second point of agreement for the entire group was an acknowledgement of the usefulness of cost-benefit analyses (CBAs), which are carried out in all the countries of Europe, but participants emphasized that this was one tool among several for providing an initial indication to the authorities responsible for taking decisions to build transport infrastructures. The group agreed not to debate the way in which such CBAs are carried out, even though a number of interesting remarks and criticisms were formulated since this topic was the object of concerted action within the context of EURET.1 concerning investments in road infrastructures. The group nevertheless reiterated its reservations as to the feasibility of comparing the data which resulted from such cost-benefit analyses carried out in Europe, given the different types of indicators taken into account, on the one hand, and disparities introduced into the definitions qualifying these indicators on the other.

The third point which the experts wished to stress was the need for studies to be carried out aÊposteriori and over a long and possibly even very long period of time after a major transport infrastructure had been built. Almost all the studies carried out to evaluate transport infrastructures are in fact produced "*exÊante*" as an aid to the decision-making process and are practically never compared with "*exÊpost*" analyses in order to observe and interpret any changes (or lack of changes) to an area that have been caused, or not, by the infrastructures in question.

Fourthly, the Group stressed the importance of retracing at all levels and on all spatial and temporal scales the decision-making processes which have led to a major transport infrastructure being created. This makes it possible to situate the results observed in relation to the context which prevailed when the decision was taken and as events subsequently evolved. There is a need to recognize that there are various methods for evaluating the effects of major transport infrastructures. It was not a good idea to transpose the results from one region to another because the structures themselves and the decision-making framework from which they originated were specific.

2.2 Main topics discussed

The use of models. Some experts expressed confidence in using models to evaluate the effects of transport infrastructures (FrankÊBruinsma, RicoÊMaggi). Others demonstrated that, even if a worthwhile model were used, errors could be made in the interpretation of the results (FrancisÊCheung). It was also possible to be confused about the concepts underlining the use of models, thus producing errors of methodology (DominiqueÊSchwartz).

The problem of transparency. This aspect was highlighted in the case of using models created for the most part by experts and consultants and whose function too often remained obscure (FranoisÊPlassard, KenÊGwilliam). If different methods led to very divergent results, it was essential to publish them in full (ClaudeÊJeanrenaud).

Quantitative and qualitative studies. Some experts expressed the opinion that there was a need to dissociate these different approaches (FrancisÊCheung), while others, on the contrary, wanted to develop a method for measuring and associating the different studies (FrankÊBruinsma). Doubts were raised about the thoroughness of research projects carried out using the only data available (EddyÊVanÊdeÊVoorde).

Taking the effects of construction into account. Some experts wanted these to be included in evaluation studies because decisions were often founded on direct and short-term effects (RogerÊVickerman). Others were opposed to this approach as they considered this category of "effects" as pecuniary and investment multiplier effects (ClaudeÊJeanrenaud). Account must nevertheless be taken of the weight of this argument in the decision-making process, as some countries were concerned with and demanded an analysis of direct effects on employment (FrankÊBruinsma, PardipÊBans). This argument is even quoted explicitly as a priority in official documents of the European Community, such as JacquesÊDelors's White Paper (GuyÊJoignaux, OdileÊHeddebaut).

Cost-benefit analyses. With the reservation of the remarks set out above, which express a consensus in the group, some experts wanted to add further points. Some, for instance, justify the taking into account in CBAs of "effects on tourism developments" while others consider that it is a technical error to include them in this type of analysis (ClaudeÊJeanrenaud).

The definition of effects. This topic seems to give rise to controversy regarding the definitions of the effects of infrastructures. Discussions on this theme reveal a real need for clarification and taxonomy (ClaudeÊJeanrenaud). The value of measuring "proximity effects", and on "improving accessibility effects", was debated even though this notion also gives rise to difficulties of definition.

The problem of data availability. Almost the entire group considers that this is a key question. The risk of data on transport flows disappearing and the quality of information on the movement of persons and goods within the European Union already emphasized in the conclusions and recommendations of COSTÊ312 poses a real problem for those who need to study and understand new traffic-related phenomena within and outside the Union. What is more, some experts expressed their doubts as to the validity of research carried out with models using incomplete data (FrancisÊCheung, KenÊGwilliam).

Enumerating objectives assigned to transport infrastructure. This notion was endorsed by the entire group, but with nuances regarding the objectives in question, which can in fact vary considerably depending on one's position at various points of the decision-making process. At European level, for instance, much is said about the objective of economic and social cohesion, the free movement of persons and goods and of relaunching the economy on the model of the "New Deal", in which latter category we can mention industrial objectives. These may, moreover, be contradictory, leading to such phenomena as a two-speed Europe or the strengthening of the centre at the expense of the periphery, etc. At national level, we could be talking about town and country planning objectives to achieve a national balance or to bring major cities closer together and to develop them, while at regional level the accent may be placed on economic and social development, especially in regions that are being restructured and where transport networks are being reorganized.

The way in which the role of transport infrastructures is represented. This field of research has not yet been widely explored. The problem lies in assessing the other, non-transport missions which may be ascribed to transport infrastructures (FranoisÊPlassard). Transport infrastructures are still subject to theories of cause and effect which justify the use of simplistic models and imprecise data (DominiqueÊSchwartz). Some experts proposed that the function of transport infrastructures should be considered (RicoÊMaggi).

Taking into account the "strategies of players and accompanying measures". Some experts were extremely reluctant to consider these fields because the contexts for intervention very often differed from one country to another or even from one region to another (RogerÊVickerman). Others were convinced that not only accompanying strategies but also decision-making processes should be included in analyses of the effects of major transport infrastructures, precisely because these contexts differed, thus permitting comparisons of the various contexts, while the infrastructures were the same or of the same type (OdileÊHeddebaut, ClaudeÊJeanrenaud, RicoÊMaggi, NagibÊBenchekroun).

Should the subject of evaluation be the relevant section, the network or the systemÊ? The need to study transport infrastructures by resituating them within an overall transport system (FranoisÊPlassard) was advocated by almost the entire group. Limiting oneself to studying portions of the network can obscure the fact that new investments may jeopardize old investments (Dominique Schwartz).

Problems of transposing research to other transport infrastructures. Some experts voiced a number of doubts as to the feasibility of transposing observation and evaluation methods relating to major transport infrastructures (AndrewÊBurchell). Others wanted to encourage research projects to compare major infrastructures with each other, such as the Straits of Gibraltar tunnel (NagibÊBenchekroun), or the new transAlpine links (RicoÊMaggi).

2.3. Recommendations by the group of experts

Point 1: The group's official position is to affirm that knowledge making it possible to predict with any certainty the effects of transport infrastructures is either insufficient or totally inadequate. In addition, there is a need to draw a clear distinction between *exÊante* and *exÊpost* evaluations by favouring a policy of transparency in these studies. In other words, the hypotheses used need to be spelt out, the methodology followed clearly explained and the indicators or the nature of the data or elements considered precisely defined.

Point 2: The experts recommend that the objectives assigned to a transport infrastructure project be presented clearly. This amounts to giving a rigorous definition of the project, its size and significance at European, national or regional level, and the objectives envisaged for each category of player and agent, whether they be the decision-makers (politicians) at each level of decision-making, technicians, operators, users, firms, etc. Such a definition would also include ways of financing, duration of the project and so on. The experts also advocate asking the question whether such objectives could not be achieved by other means than by building a major transport infrastructure.

Point 3: The experts recognize that a cost-benefit analysis is an essential tool, but the reflections and reservations listed above should be borne in mind. They insist that such reservations should be published, whatever the results presented.

Point 4: The experts advocate that transport infrastructures should be evaluated, both in *exÊante* or *exÊpost* studies, in a way which situates them in a general transport system. This means that not only the section of the infrastructure to be constructed should be considered, but also its place in a transport network and its modal, intermodal or multimodal way of operating.

Point 5: The group stresses the interest of taking into account, whenever they exist, "accompanying measures" which are instituted when a transport infrastructure is built, by identifying the various strategies of players implemented at each level of decision-making and for each territorial and spatial level, and also by identifying the breakdowns and origins of the financing for such accompanying measures.

Point 6: The group would like research to be carried out to try and identify and classify that which is measurable or not, in quantitative or qualitative terms, that which is assessable or not, desirable or not, predictable or not when it comes to evaluating major transport infrastructures and the methods to be used in each case.

Point 7: The group of experts is anxious to alert the European and national authorities to the real deficit of knowledge in the economic and social fields linked to transport which is not covered by research programmes, whether under the fourth FRDP, or the French PREDIT programme. It recommends exploring and developing new fields of knowledge including, among others, changes regarding the mobility of people and goods, the factors which determine the location of activities, players' strategies, psycho-sociological representation systems, the territorialization of public policies and town and country planning policies.

Point 8: The group also wishes to draw the attention of the European and national authorities to the problem raised by the disappearance of data sources in the field of transport or on the confidentiality aspect invoked by operators in the interests of competition with other modes of transport. It advocates that the recommendations already made in the final report on COSTÊ312 regarding this subject be taken into account. It also suggests that, when decisions are taken to build transport infrastructures, each decision should be matched with a report which compiles the data clarifying why such decisions have already been taken and also throwing light on those which will be taken in the longer term. It recognizes the need for new techniques for gathering data in statistical or observation terms. To this end, the group would like research to be undertaken to determine the "indicators" or "significant variables" to explain the links between transport, space and territory, even though it is aware that there is no agreement in the scientific community regarding the theoretical references for explaining these links.

Finally, the group of experts stresses its conviction that there is no single and uniform approach for evaluating major transport infrastructures. It points out the interest of studying the Channel Tunnel as an ideal opportunity for observing possible changes in economic and social behaviour, changes in mobility and in the movement of persons and goods, for understanding innovative reorganizations of networks, of operating systems of territories according to the scales considered, and of space. The experts are aware that such observations should be carried out over long periods and in areas of scientific research which cover as many interdisciplinary aspects as possible.

GENERAL CONCLUSION

At this stage of COST 317's work, a consensus has gradually emerged between the various national delegations around three points :

1. on the **scope of the analyses** developed in this report,
2. on the problems raised by **taking into account the effects** of major transport infrastructure,
3. on the need to set **guidelines** for future research and for evaluations under way or to come.

1. General comments

COST 317 has gone through several stages which have resulted in its objectives being appreciably redefined. This interim report is therefore a presentation of the "state of the art" with regard to evaluating the socio-economic effects of major transport infrastructure : it presents the results of a considerable amount of work to collect information supplemented by elements of analysis making it possible to lay markers for the following stage. It shows clearly that the practices applied in the evaluation of socio-economic effects are still developing, that they reflect to a large extent different cultures, and that there is currently no body of theory which is generally accepted in this field.

1.1. State of the art

Given the variety of objectives assigned to the various major infrastructure projects and the methods used by the different countries to evaluate the socio-economic effects, it was not possible to adopt a standard theoretical basis for the evaluation. Although the objectives initially set for COST 317 included the development of a method of evaluation, the work undertaken as part of the project has clearly shown that it is impossible to achieve this objective. It was all the more urgent and important therefore to set about collecting a wide range of information available on this matter in the various countries.

1.1.1. The collection of data

On the basis of the information provided by the national delegations, it has been possible to draw up a fairly comprehensive overall picture of the methods of evaluation used in the various countries to evaluate the consequences of transport infrastructure on the socio-economic environment. This data has shown that these methods of evaluation are used more or less exclusively *"ex ante"* ; they are attempts to identify the potential effects of major infrastructure before it is brought into service, but there is little research afterwards to verify the claims made. The fact that there is no information from Germany is without doubt a shortcoming, all the more unfortunate since Germany showed great dynamism on these matters in the 1970s.

1.1.2 The reflection of different national cultures

Across all the methods identified, it is clear that each country has different practices which reflect different national cultures. While not wishing to accentuate this difference, two broad types of procedure can be distinguished which correspond i) to the culture of northern European countries and ii) to that of southern European countries.

- the countries of northern Europe, such as Denmark, Sweden, the Netherlands and the United Kingdom prefer to adopt approaches based on modelling or which largely seek to quantify effects using models ;
- the Mediterranean countries prefer to apply less formalised analyses and have developed analyses which are more critical of the methods of evaluation of these effects, or have even brought into question the concept of effects.

1.1.3 The technique of satellite images

Since the years 1980, remote detection techniques using satellite images have been developed in numerous technological and scientific areas. They are measurements (quantified images) taken at distance from instruments located in a satellite. These information are more accurate (1/250Ê000) than the aerial images (1/50Ê000 to 1/5 000). They can be digitalised and exploited in combination with other information in order to help decision makers or to follow spatial impacts. These combinations refer to complicated methods which need a high level of skill. Their applications in the nearest field which interest COST 317 are in the main areas of settlement of rail or road infrastructures or in the following of the landscape, activity and inhabited area evolution or transformations.

Applied to the Channel tunnel [114] it could be possible to obtain diachronical images (to be determined) of physical factors (ie: landscape, inhabited areas, infrastructures, harbour estate) reputed to be in the sphere of influence of transport networks. These physical images would have to be linked with socio economic or demographic data to suggest assumptions in order to be interpreted. Obviously, these techniques itselves can only give indications on the land transformation. They will never indicate the reason of these modifications. Moreover, their combination with other information systems is probably not easy and it is not sure it could help the understanding of these movements. Finally, if these satellite images could usefully give information on the physical evolution of space, they remain unable to explain the socio-economic characteristics of these modifications. Nevertheless, it is an important request of the problematic of the socio-economic effects of the Channel tunnel.

These techniques remain quite expensive and it is expected that the realization of such a satellite image acquisition and treatment programme would cost between 0.2 and 0.3 million of Ecus for 5 successive observations.

1.2 Practices which are developing

In addition to this variety in national practices, it has emerged that the practices developed rapidly over the years. The development of critical analyses has influenced all national practices and although some models are used to forecast effects, they are used with ever greater caution. The gradual abandonment of the cost/benefit analysis as the only method and its use as one of a number of methods also reflect changes in behaviour perceptible over

[114] See the synthesis report established for the COST 317 Management Committee by Michel POUYLLAU (UMR CNRS Regards, Bordeaux) and Franois CUQ (URA CNRS GŽosystmes, Brest)

recent years. It will therefore no doubt be necessary to wait a few years more before a generally accepted paradigm becomes established in the evaluation of socio-economic effects.

2. The points of agreement of COST 317

Despite this diversity, the national delegations which took part in COST have identified points of agreement on the subject of the evaluation and the difficulties of apprehending it.

2.1 The difficulties inherent in the subject of the evaluation

The preceding pages have largely shown the difficulties in reaching agreement on a single definition of the effects of major transport infrastructure, since these definitions presuppose agreement on the delimitation of the various areas of reference and the significance of effects.

2.1.1. Delimitation of the area

The difficulties encountered in the process of evaluation are inherent in the difficulty of delimiting the area in which the evaluation applies :

- is what is intended an economic evaluation where the indicators reflect in particular the phenomena of regional growth and variation in employment, or is it rather a social evaluation with other indicators or both at once.
- what geographical range is adopted for the evaluation : is there a wish to show the effects of proximity, on a local scale, or the effects of the geographical redistribution of activity to other regional, national or even European scales?
- finally, the nature of the effects is not the same depending on the timescale chosen : certain micro-economic effects of proximity are evident in the short-term, while long periods are necessary to detect geographical transformations.

2.1.2. The significance of effects

The socio-economic effects of major transport infrastructure must therefore be described more accurately and in advance of the process of evaluation. However, even if agreement could be reached on a definition of the effects, one difficulty would remain : suitable techniques for forecasting effects with a minimum risk of error would not do away with the need to interpret these effects and specify the connection between the variations forecast and the decision to build the infrastructure. This explains why extra jobs may be welcome in a less-favoured area, but considered undesirable in an area where traffic or population density is reaching saturation point.

All these matters finally refer back to the objectives which are assigned by decision makers to the planned infrastructure. Only where these objectives are clearly set is it possible to define the effects and evaluate them. Difficulties still remain however.

2.2 The difficulty of apprehension

There are in fact many difficulties in apprehending these effects.

1. The transformations in economic structures, both at the level of the conditions affecting industrial production and at the level of the geographical organisation of activities, generally appear only after a considerable time. These effects become evident in the long-term, as historians have demonstrated.

2. In industrialised countries, new transport infrastructure generally only brings a marginal modification in the conditions of accessibility. The effects will therefore be in line with the marginal nature or otherwise of the project.
3. Although transport conditions are often a decisive factor in economic development, they combine with many other factors to affect the pace of economic development. It is therefore very difficult to give transport credit for a proportion of this extra identifiable development.
4. Although, using various methods, it is possible to detect a difference between the situation which prevailed before the construction of the infrastructure and the situation following construction, it is still extremely difficult to specify whether the change detected corresponds to increased growth, activity or jobs or is simply the result of the geographical redistribution of activity. This difficulty refers back to the variety of possible geographical scales used in viewing the situation : at the regional level, it might be considered that these transformations are additional wealth, while taken at the national level they can only be a new geographical distribution of the same activities.
5. By means of the gains in productivity which they may give rise to, improvements in transport conditions may promote the **integration of markets** or an **increase in competition**. It is difficult to foresee before construction of the infrastructure which of these factors will be promoted and whether the objective of decision makers with regard to economic advantages is to promote market integration or competition.

2.3 The limits of the cost/benefit analysis

In these circumstances, the delegations agreed on the advantages and the limits of the cost/benefit analysis, with regard both to its strictly neoclassical theoretical foundations, and to its inability to take account of certain effects and their geographical range. Cost/benefit analysis is very generally used in the various countries as an aid to decision-making on major transport infrastructure. The quality of its results depends to a considerable extent on that of the traffic forecasting models the results of which may need to be treated with caution over excessively long periods. Its characteristics mean it can remain a useful instrument for evaluating the financial return of projects.

However, as soon as the attempt is made to integrate socio-economic effects in the evaluation, this technique proves to be inappropriate as these effects are of a different order from the costs and receipts taken into account in cost/benefit analysis.

This method is unable to take account of the modifications in structures (social, geographical, economic) and in behaviour (companies, individuals, households, groups, decision-makers) likely to be brought about by completion of the infrastructure.

3. Guidelines

The main lesson which the group is inclined to draw is the need to move away from an evaluation based on a single method. In evaluating major transport infrastructure we would therefore recommend :

- pluralist approaches, based on several viewpoints ;
- methods geared to each type of major category of project, although certain tools must compulsorily be present in any evaluation ;

- methods combining quantitative and qualitative approaches ;
- an explanation of the causal postulate underlying each of the methods.

These recommendations set the outlines for what could be a "joint protocol" for the evaluation of major transport projects. They should however be supplemented since, as revealed by the group's discussion and work, some areas of research are insufficiently explored. One of these avenues is the use of satellite images to monitor the spatial transformations following the introduction of major infrastructure. It is not the only one, however.

Another recommendation involves the necessary harmonisation of data and indicators used, also within the cost/benefit analysis. The objective of standardisation of definitions or, more modestly, of approximation of the methods requires as a preliminary step the harmonisation of definitions and concepts and therefore of data collection.

Finally, it appears necessary to locate the evaluation in relation to its subject in order to define its area of validity. For example, the methods of evaluation to be applied will not be the type if the questions asked with regard to infrastructure are linked to finance rather than to more general objectives of regional planning or local and regional development.

These comments refer back to the decision-making process itself, which will need to be clearly identified : the objectives expected of the new infrastructure must be clearly set out to locate the place of the evaluation in the overall context of the decision-making process. Finally, whatever the methods and their characteristics, the information which they provide is part of the socio-economic evaluation, and leaves the political decision to be taken in full autonomy.

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