



# **Transport megaprojects in Italy. A comparative analysis of economic feasibility studies into EIAs.**

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## **Abstract**

The paper presents a survey conducted on the environmental impact assessments and the feasibility studies for fifteen selected infrastructural transport projects all over the Italian territory and approved under the so called “Objective Law”. The survey collects data concerning the demand forecasts, the definition of alternatives and the cost benefit analysis, with their level of detail.

The aim of such work is to derive some general considerations about the quality, the transparency and the contents of the assessment, in the context of the Italian normative framework.

For the analysed projects, it is possible to recognise a lack of contemplation to the definition and in the construction of the demand forecast model, the use of extremely standardised schemes of comparison, the presence of double counting and some theoretical errors concerning costs evaluation. Moreover, the parallel analysis of different projects on the same study-area shows, in some cases, the absence of any coordination among projects, as well as different outputs from the transport demand forecast model; this creates problems in validating and comparing the results of each analysis.

After an introduction to the normative framework, the adopted methodology is presented. After that, the paper – reflecting study objectives – includes first, an analysis of alternatives definition and tools used for the decision support system; second, the discussion and comparison of the demand forecasts quality; third, the approach used for the quantitative economic assessment. Then, as example, the standardised railways operator procedure has been analysed and commented. Finally some conclusions will be drawn.

*Keywords:* Evaluation; CBA cost benefit analysis; Transport infrastructure; EIA environmental impact assessment.

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## **Normative context and paper aims**

Due to a real or apparent deficit in national infrastructure, transport planning in Italy has, of late, been intensive. The 2<sup>nd</sup> General Plan of Transport and Logistics (“PGTL”)

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was published in the year 2000, followed in 2001 by the “Objective Law” (L. 443/2001, “*Legge Obiettivo*”). This law consists of delegating infrastructure and national development to the Government. The Government can produce a list of public and private investments, following some in-house criteria and guidelines (but not declared on a plan nor in law), like the filling of the infrastructural gap between the North and the South of the country or the increase of national competitiveness. The law declares its own consistency with the General Plan of Transport and Logistics of 2000, but in fact the Government can freely express a list of infrastructure, as it did. Consequently the PGTL, if still in effect, has been made redundant as a planning document by the Objective Law<sup>1</sup>.

A key point to be explored in such planning context, is the relation between the economic feasibility study (Cost Benefit Analysis in the Italian normative) and the Environmental Impact Assessment (EIA)<sup>2</sup>. The law 443/01 (and the following decree DLGS. 190/2002) partially reform the procedure of the EIA. Among other measures, the reform makes both the approval and start of the chosen investments easier and faster.

Concerning the verification of such evaluations, the L. 308/2004 establishes that (comma 9, letter f) the EIA procedures must consider the cost/benefit ratio of the project from the environmental, economic and social point of view. APAT, the former National Agency of Environmental Protection, published a document containing the guidelines for the evaluation of EIA studies (APAT, 2001). Among the criteria of evaluation and possible rejection of a project by the Ministry of Environment, there are the “criteria of preventive verification”:

*... they take their origin from different evaluation contexts (economic cost/benefit, technological feasibility). The EIA **must simply verify** that these evaluations took place in order to avoid the occurrence of useless or technically wrong investments that produce [...] unnecessary impacts on the environment. ...<sup>3</sup>*

In addition, one must consider that the feasibility studies and the subsequent EIA (even if not indicated by the EU normative as a tool for economic impact verification) are the only aspects of the process in which a compulsory and public socio-economic evaluation of projects takes place.

Alternatively, it would be useful defining the main and unavoidable elements forming a correct evaluation (alternatives selection, demand forecast methods, economic feasibility algorithm). Only a correct assessment can aim to justify the choice of one project from a shared and clear planning context, as in the Italian situation. The use of “shopping lists” in addition to inconsistent evaluations can potentially justify projects without any social or economic justification. Of course, the definition of a correct evaluation is not entirely obvious, but the international practice and literature can help in doing so.

The aim of this study is thus to verify in a sample of EIAs if some key aspects of the evaluation and decision making that concern infrastructures take place in a correct, shareable and transparent way. The presented material itself can provide some

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<sup>1</sup> Brambilla et al (2003) reports 80 interventions in the initial phase, becoming over 200.

<sup>2</sup> defined by Italian law DPCM 27/12/1988.

<sup>3</sup> APAT, 2001, page 19. The bold and the translation are by the author.

significant judgements about the quality of projects and allows us to draw some conclusions about the inadequacy of the Italian normative concerning project selection.

## Methodology

The approach used for the analysis of the quality of assessment is based on a comparison grid, including the most relevant aspects concerning the evaluation of investments<sup>4</sup>. The focus is on the aspects of defining alternatives, demand forecast and economical analysis; all of which concern the decision making process. The analysis is done by answering whether some aspects of project assessment, that theory and international practice suggest, are present and correctly treated. The filling of the grid is, of course, a partially arbitrary operation because it sometimes implies some judgements by the author, but with acknowledgement to literature and laws.

Table 1: projects analysed.

	Proponent	Short name	Project description
H1	CTM	Region Lazio	Highway link Roma - Formia: "Corridoio Tirrenico Meridionale".
H2	A4 Milan-Turin	ASTM	Upgrade of Turin – Milan highway.
H3	Pedemontana	Region Lombardia	Highway link Dalmine-Como-Varese, Gaggiolo pass and related works.
R1	Paullese	Milan Province	Upgrade of provincial road between Peschiera Borromeo and Spino d'Adda
R2	Valtellina	ANAS	Accessibility to Valtellina valley
R3	SS77	ANAS	SS77 Val di Chienti; Umbria - Marche road system ("Quadrilatero Umbria - Marche")
R4	Modena – Sassuolo	ANAS	Highway link Modena - Sassuolo - Campogalliano
L1	Brenner	BBT	Upgrade of rail link Munich – Verona and Brenner Base Tunnel.
L2	Verona-Brenner	RFI	Railway line Verona – Fortezza, 4th track.
L3	Foligno-Fabriano	RFI	Railway line Orte – Falconara. Foligno – Fabriano section doubling.
L4	Falconara	RFI	Falconara (Ancona) rail node and link between Orte – Falconara line and eastern coastal line.
L5	Terni-Spoleto	RFI	Railway line Orte – Falconara, doubling of Spoleto – Terni section.
L6	Pontremolese	RFI	Railway line "Pontremolese"
L7	Rho-Gallarate	RFI	Upgrade of Rho – Arona rail line, section Rho – Gallarate.
L8	Verona-Padua	RFI	High speed/High capacity railway line Verona – Padova.

Elaboration of the author.

The grid, which will be fully detailed in the following sections, aims to include and systemise the most relevant aspects forming a functional, transparent and impartial evaluation, pointing out potential biases and errors present in the EIAs. Good practice is suggested by the theory cited in literature concerning the implementation of EIA procedures (Baccaro et al., 2005 for the Italian normative; European Commission, 1997)

<sup>4</sup> The quality of environmental analysis, even if extremely relevant for the decision and the design of the infrastructure, has been excluded from our comparison.

or by experience and common sense (for example when it is stated that it is meaningless to compare only one alternative). Specifications are provided in the following sections.

The sample analysed is made of fifteen homogeneous<sup>5</sup> projects, listed in the Table 1. Seven of them are road or highway projects, eight are rail lines or nodes. For all of them the official EIAs and CBAs have been analysed<sup>6</sup>.

The grid has primarily been filled in with articulate descriptive answers. However, to be easily represented here, it has been simplified using a yes/no format. In the following sections, the most relevant aspects are illustrated in table and graph format. The green bars of graphs represent the number of projects for which a positive answer has been given, in red the negative. For some projects data has been incomplete. In this case the bar is shorter than the total number of projects (15 in total or 7 road + 8 rail). More details about methodology and assumptions will be given in the next sections.

### **Definition of alternatives and decision tools**

The issue of defining alternatives is very relevant and delicate. According to the common theory of assessment (see next paragraph), the definition of alternatives should be done during the planning phase in order to highlight the most compatible and feasible solution. In this respect, the EIA should not consider alternatives, but highlight environmental concerns. In this sense, according to directive 97/11/CE (art 5, comma 2), the evaluation activity in the EIA can be limited to a function of support.

Nevertheless some path alternatives are presented in EIAs where their purpose is not only an environmental impact minimisation. These are usually analysed, and chosen, also in terms of functionality, technical feasibility, investment cost minimisation (even if considering investment only, instead of life cycle total cost), consistency with planning tools and so on.

The scheme used here for comparison is articulated into four main areas: the number of alternatives considered, their extent, the level of description, the use of such scenarios. The following table includes all the results for each project and for each criterion considered<sup>7</sup>. The following paragraphs will comment the results.

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<sup>5</sup> All projects refer to the same laws and have been assessed during the same government. However, the authors of the projects and EIAs are various.

<sup>6</sup> In some cases the Ministry of Environment required additional parts concerning the aspects analysed. When additions can be considered more satisfying, this study considered them, instead of the original documents.

<sup>7</sup> In the table, “yes” means that the element is present and/or correct, “no” that is absent and such absence constitutes a conceptual error. The blank means that it was not possible to answer or that the answer has no sense. For example, “no alternatives” is applicable only if the other criteria are “no”.

Table 2: results of the analysis of alternatives.

Project:		H1	H2	H3	R1	R2	R3	R4	L1	L2	L3	L4	L5	L6	L7	L8
Alternatives and scenarios considered	Do nothing			yes	yes	yes		no	yes	yes	yes	no	no	no	no	no
	Base case	no	no	yes	no	yes		yes	yes	no	no	no	no	no	no	no
Extent of alternatives	One alternative only	yes	yes		yes	yes	no			yes						
	>2 projects	no	no	yes	no	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes
Level of description	modal alternatives	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
	corridor alternatives	no	no	no	no	no	no	no	yes	no	no	no	yes	no	no	no
	path alternatives	no	no	yes	no	yes	yes	yes	yes	no	yes	yes	yes	yes	no	yes
	minor differences	no	no	yes	yes	no	yes	yes	no	yes	no	no	yes	no	yes	no
	no alternatives	yes	yes													
Use of the alternatives	description only	no	no		yes		yes	yes						yes		yes
	partial design	no	no	yes	no		no	no	yes	yes	yes	yes		no		no
	full design	no	no	no	no	yes	no	no	no	no	no	no	yes	no	yes	no
Use of the alternatives	simulation model	no	no	no		yes	yes	no	yes	no	no	no	no	no	no	no
	evaluation model	no	no	no	yes	yes	no	no	no	no	no	no	no	no	no	no

Source: elaboration of the author.

### Alternatives and scenarios considered

A consistent evaluation requires the definition of a base scenario and some alternative projects. The literature is full of prescriptions for the building of a correct base scenario. Among others, EU guidelines (Florio, 2003) give the definition of a “do minimum” scenario (the less costly solution to the problem) together with a “do nothing” (to keep the present situation). For Eijgenraam (2000) it should be a combination of the best, alternative application of the available investment resources and the best possible alternative solution for the problem that we want to solve with the project. In general, national guidelines apply similar definitions for the do-minimum as reference scenario (for example: HM Treasury, 1997).

The first step of this survey then aims to verify the presence of a well defined base case or, at least, a do nothing scenario (it would be *wrong* to compare future alternatives with a reference solution that will never exist). On second thought, one must verify the existence of more than the chosen alternative only, in order to make significant its choice. The feasibility of a project, in fact, doesn't demonstrate *a priori* that it was the best in absolute terms and that some better unexplored alternatives didn't exist<sup>8</sup>. In certain cases the best solution could be the reference solution.

<sup>8</sup> The discard of socially viable alternatives can be accepted only in the case of technical limitations. This, however, is the only instance and the presence of more than one alternative nevertheless makes the selection more significant.

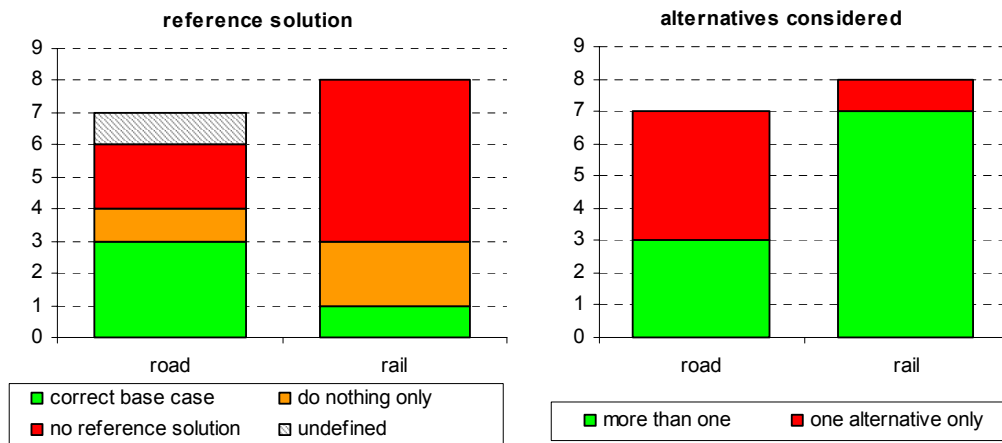


Figure 1: results, reference solution and number of considered alternatives.  
Source: elaboration of the author.

The results of this analysis doesn't seem generally positive. Only 10 projects out of 15 include more than one alternative: the chosen project is not compared, but simply verified. Even more problematic is the absence of a base scenario in the majority of projects (present only for 4 out of 15). Rail projects tend to show more than one alternative, and are consequently better in this respect, but show shortcomings for the base case. Road projects show the opposite effect.

#### *Extent of alternatives*

Apart from the actual presence of alternatives, their extent is even more important. One can consider modal alternatives, corridor alternatives, path alternatives, minor detail differences or no alternatives. The majority of projects (10 out of 15) include only path alternatives or (7 out of 15) minor differences. Real corridor or modal alternatives are present only in 2 projects (Brenner Basis Tunnel and Terni-Spoleto line). Two projects consider no alternatives at all (A4 Milan-Turin and Roma-Formia). Rail projects have been better in these terms with respect to road ones.

#### *Use of alternatives*

A key point is the use of defined (and sometimes fully designed) alternatives. If such definition is irrelevant for demand forecasts and evaluation phase, the alternatives can be considered fictitious.

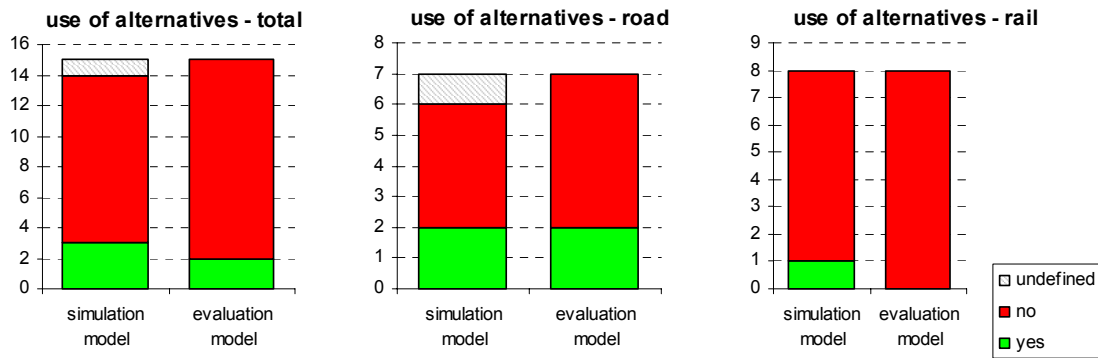


Figure 2: use done with defined alternatives.

Source: elaboration of the author.

The results are poor; the projects in which alternatives enter in the demand model or the evaluation phase are three and two, respectively, out of 15. One can affirm that the alternatives are usually formally presented in order to fulfil the EIA's requests, but these are irrelevant for the choice. Sometimes the choice of the path is done *a priori* using technical criteria only. The most complete study is the *Valtellina* road access, with alternatives used both in simulation and CBA. The only rail project is the Brenner Basis Tunnel.

## Demand forecasts

The demand forecasts are key elements in any transport study. Any infrastructural improvement should be the consequence of demand, real or presumed, and therefore the nature of this demand must be justified. A demand study is therefore essential in demonstrating the necessity of the project, before any socio-economic feasibility consideration, showing its impacts on ecosystems and human beings.

The Italian law requires explicitly to define and report<sup>9</sup> the degree and level of demand fulfilment with and without the project, plus the quantitative forecast of the demand-supply ratio. The building of infrastructure with relatively small amounts of traffic is not in accordance with the Ministry of Environment guidelines (ANPA, 2001), since it causes unnecessary environmental damages.

The scheme used for analysis and comparison is formed by the following areas; the nature of the forecasts, the methods used for the forecasts and for flow assignment, the transparency and reproducibility of the procedure, the boundaries of the analysis, and some technical aspects of the models used. The full results are in following table<sup>10</sup>, details come further.

<sup>9</sup> DPCM 27/12/1988, Art. 4, c. 2, lett. b) and c).

<sup>10</sup> In the table, "yes" means that the element is present or is correct, "no" that it is absent and such absence constitutes a conceptual error, "?" that the answer wasn't possible due to lack of information. The blank means that the issue was not present. For example, in the section "method used" it has been marked "yes" only for the method used.

Table 3: results of the analysis of demand forecasts.

Project:		H1	H2	H3	R1	R2	R3	R4	L1	L2	L3	L4	L5	L6	L7	L8	
Quality of the forecast	weak considerations	no	yes								yes	yes	yes	yes		yes	
	qualitative evaluation	no	no								no	no	no	no		no	
	quantitative evaluation	yes	?	yes	yes	yes	yes	yes	yes	yes	no	no	no	no	yes	no	
	traffic surveys & data	yes	yes	no	yes	yes	yes	yes	yes	yes	no	no	no	no	no	no	
Method of demand forecast	qualitative / "supply side"									yes	yes	yes	yes	yes	yes	yes	
	use of trends	yes	yes	yes	yes	yes	yes	yes	yes	yes			yes		yes		
	link to GNP					yes	yes										
	use of elasticity																
Model used for flows estimation	assignment model	yes	no	yes	?	?	?	yes	yes	no	no	no	no	no	no	no	
	integrated land use model	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	
	Clarity and transparency	clear data and hypotheses	yes	yes	no	no	yes		yes	yes	no	no	no	no	no	no	no
		possible to reproduce	yes	yes	no	no	yes	no	yes	yes	yes	yes	yes	no	yes	no	no
Boundaries	time horizon correct	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		yes	yes	no	yes	
	space boundaries correct	yes	no	yes	no	yes	yes	yes	yes	yes	no		no	no	yes	no	
Model	presence of sim model	yes	no		yes	yes	yes	yes	yes	yes	no	no	no	no	no	no	
	only declared			yes	yes												
	calibrated	yes		yes	?	yes	yes	yes	yes	yes							
	validated	no		?	no	no	no	?	?	?							
The model is common with other projects?		no	no	no	no	?	no	no	yes	yes	no	no	no	no	no	no	

Source: elaboration of the author.

### Quality and nature of the forecast

Forecasts do not always follow a quantitative rational procedure, as the problem suggests, but sometimes are ruled by weaker qualitative considerations. Only for 9 projects the forecasts are treated in quantitative terms.

Another element that should be explicitly analysed and documented is the presence of traffic surveys and the proof of simulations. Traffic surveys are necessary to size the infrastructure, to be the basis of forecasts, but also, in theory, to calibrate and validate the models.

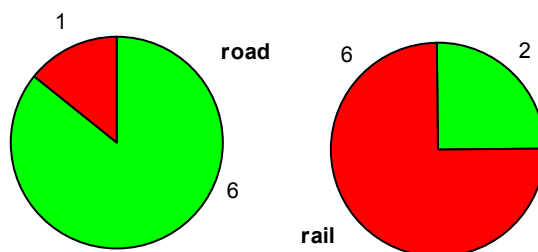


Figure 3: presence of traffic surveys in public documentation.

Source: elaboration of the author.

Traffic surveys are very common for road projects, but not for rail (only the two Brenner projects give indications about the actual and presumed traffic). At first sight this is counterintuitive, since the rail EIAs are designed by a sector of the rail operator



itself: the operator should know, at least, the actual number of passengers/freight, but no data is provided apart from the number of trains.

*Method used for forecasts*

Many ways currently exist to produce forecasts. For simplicity’s sake, only six are considered. These are not “methods”, but the ways in which the designer approached the problem. More than one can be used at the same time:

- Qualitative. The future demand is quantified by qualitative assumptions only, for example making an hypothesis for the number of future trains and their load factors.
- Use of trends. The application of trends to actual traffic or demand is the simplest way to make forecasts. The trends can derive from various sources, of course to be always declared.
- Link to GNP. A common hypothesis is to link the increase of demand to GNP rate.
- Use of elasticity. That is to say the use of generalised cost elasticity in order to link the demand with the supply, where necessary according to some scenarios. Multi-modal models, if used, include an implicit elasticity.
- Macroeconomic scenarios. The definition of scenarios, more than one, can simplify the forecast allowing to make undemonstrated hypotheses. On the other side it is necessary the clear explanation of all the assumptions done and the use of the same scenarios until the end of the process.
- Interviews and stated preferences. Another way of forecasting future demand, frequently used in sectors such as Local Transport, consists in the use of interviews together with the technique of stated preferences.

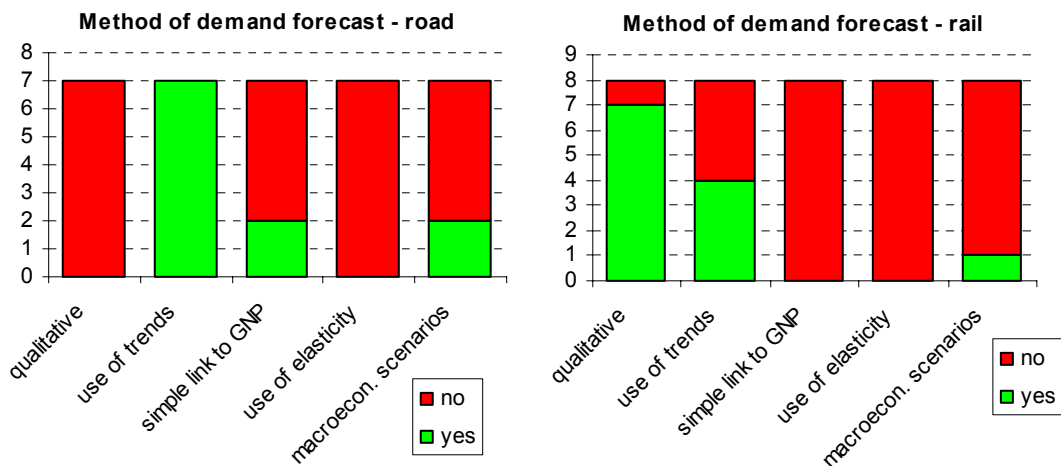


Figure 4: methods used for the forecast of the demand.  
Source: elaboration of the author.

The survey shows clearly a predilection for trends in the road project, sometimes according to different scenarios (A4 Highway and “Pedemontana” Highway). Rail sector projects are done, apart from Brenner, by the same designer (RFI) and use the same approach to future demand estimation, described later in the example, and defined “supply side approach”. The “method” can be classified as qualitative, and the quoted

“commercial analysis”<sup>11</sup> is not provided. No one project used elasticity or other economically founded method, nor stated preferences.

Another issue is the presence of an assignment model, to distribute the predicted flows on the present and the future network. This approach, quite common in Local Transport or Road sectors, is rarely applied in the analysed projects, despite its importance (it is available only for the Roma-Formia, “Pedemontana” and Modena Sassuolo projects).

### *Other aspects*

Concerning the other aspects, it is worth reporting the lack of clarity in data used – only for 5 projects out of 14 all data sets are clearly specified – with the possibility to reproduce the forecasts. This is more common, for example in road projects, but simply because of the large use of simple trends.

Only five road projects and two rail projects include a flow simulation model, at least declared, even if results are not always reported. For all the projects using models, some traffic data are available, so one can suppose that such data has been used for a calibration phase (even if clearly declared only in few cases). Finally, no proof of model validation is evident, since none of the designers who produced such a large model considered the importance of using a third party checking. Only two projects use a generic model, for example built in advance or prepared for general uses (Brenner Tunnel and Verona-Brenner line has a common model) rather than a project specific model.

Of this part some comments can be drawn. The study of demand is extremely complex and costly, especially for large projects such as those considered. The impacts are region-wide or nation-wide and the models to be used cannot usually be produced in a short time and for single projects. But, conversely, the analysed projects are extremely important and their total cost is very relevant. The costs to produce an acceptable traffic model, given its importance, would be more than justified. Moreover, these projects often came from large agencies, like RFI – National Railways and ANAS – National Roads. These agencies, since one of their functions is to design infrastructural investments, should have among their operative tools one national scale model common for all projects and adequately set, calibrated and validated, as exercised by other agencies (the public transport companies of big cities, for example).

### **Approach to economic assessment**

The analysed projects can be classified as “large”, sometimes as “megaprojects”, not only due to the relevant amount of money required (Warrack, 1993; Haynes, 2002), but also for the complexity of the decisional process. Nevertheless the “Objective Law” is characterised by the presence, at the same time, of mega, large and medium projects, despite the important differences among these categories. The socio-economic feasibility is clearly required by Italian laws concerning EIA (DPCM 27/12/1988),

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<sup>11</sup> see the example section of this paper for details.

while the European original version does not (directive 85/337/EEC and amended by 97/11/EC).

Table 4: results of economic analysis survey.

Project:		H1	H2	H3	R1	R2	R3	R4	L1	L2	L345	L6	L7	L8
Method used	CBA economic	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		yes
	CBA financial													
	multicriteria analysis			yes							yes			yes
	impact analysis													
	no economic assessment								yes				yes	yes
Consistency with theory	intertemporal discount	yes		yes	yes	yes	yes	yes	yes	yes	yes	yes		yes
	shadow pricing	yes		yes	yes	yes	yes	yes	yes	yes	yes	yes		yes
	elasticity explicit*	no			no				no	no	no	no		no
	correct indicators (NPV, IRR)	yes		yes	yes	yes	yes	?	yes	yes	yes	yes		yes
	sensitivity analysis for SDR	yes	yes	yes	no	yes	?	yes	yes	?	no	no		yes
	full sensitivity analysis	?		yes	no	yes	?	yes	yes	yes	yes	yes		yes
	time horizon plausible	yes	?	yes	yes	yes	yes	yes	yes	yes	yes	yes		yes
	external costs	yes	no	yes	no	yes	yes	no	yes	yes	yes	yes		yes
	continuous in time	?		yes	yes	yes	yes	no	yes	yes	yes	yes		yes
Improvements	Risk Analysis	no	no	no	no	no	no	no	no	no	no	no		no
	Option Value	no	no	no	no	no	no	no	no	no	no	no		no
	MOCPF or similar	no	no	no	no	no	no	no	no	no	no	no		no
	model integrated CBA	no	no	no	no	no	no	no	no	no	no	no		no
Evident errors*	no double counting	yes		yes	yes	no	yes	yes	yes	yes	yes	yes		yes
	no computational errors	?		yes	?	?	yes	yes	yes	?	no	?		?
	no errors in gen. traffic B	no		yes	no	no	no	yes	no	no	no	no		no
	no omissions of C or B	yes	no	yes	no	yes	yes	no	yes	no	no	no		no
	consistent B calc (base-proj)	no		yes	no	yes	yes	yes	no	no	no	no		no
	consistent C calc (base-proj)	yes		yes	yes	yes	yes	yes	no	yes	yes	yes		yes
	real alternatives	no	no	no	no	no	no	no	no	no	no	no		no
Data used	no relevant errors in input	?		yes	yes	yes	no	yes	?	**	**	**		no
	macroeconomic input ok	?		yes	no	yes	yes	yes	yes	yes	yes	yes		yes
	correct shadow pricing	?		yes	yes	yes	yes	yes	yes	yes	yes	yes		yes
	correct external costs	?		yes	no	yes	yes	no	yes	no	no	no		?
	general coher. with literat.	?		yes	yes	yes	no	no	yes	yes	yes	yes		yes
Results	Positive VAN	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		yes
	Pos. VAN for sensitivity too	?	no	?		?	?	yes	no	yes	no	?		?

\*: excluding data errors and models

\*\* : the values used are EU average instead of available Italian values.

Source: elaboration of the author.

In this section the number of assessments reported is 12, plus one with no analysis. This is due to the fact that the Orte – Falconara rail corridor (Foligno – Fabriano section doubling, Falconara rail node and Spoleto – Terni section) has three EIAs, one for each section, but only one comprehensive CBA. The most expensive is the Brenner Basis Tunnel (4.500 M€) followed by Verona-Padova HST (more than 2.500 M€) and

Fologno-Fabriano rail (less than 2.000 M€). Other projects cost 500 M€ or less; for some of them the figures are not available.

The approach used for the survey and comparison among considered projects is structured into seven main topics: which method has been used, the consistency with the theory of CBA, the presence of less conventional and codified “improvements”, the most evident theoretical errors and the recognised data errors. At the end, a check has been done on the transparency and the results of the assessments. The previous table contain the results for all cases<sup>12</sup>.

### *Method used*

The majority of projects are assessed using a CBA. Only some of them include also a multicriteria analysis to choose some minor issues (Pedemontana, Orte-Falconara, Verona-Padova). For three projects the EIA does not include any socio-economic method for alternatives choice, apart from technical or environmental aspects.

Excluding the multicriteria analyses, from this point on the focus is on the CBAs.

### *Consistency with theory of CBA*

The procedure of CBA is well established in literature, at least regarding its fundamental aspects. Many guidelines are available (Florio, 2003 for EC structural funds; CERTU, 2004 for France; NUVV, 2001 for Italy; COBA manual for UK, Eijgenraam, 2000 in The Netherlands, etc.). Among the possible schemes, this study refers mainly to the one proposed by the European Commission for the access to structural funds (Florio et al., 2003), but these elements are widely accepted. The survey considers the presence of the following issues:

- intertemporal discount. The use of a social discount rate to discount future costs and benefits (Florio, 2003, section 2.5.4).
- shadow pricing. The use of coefficients to correct distortions in prices (Florio, 2003, section 2.5.1).
- elasticity explicit or demand curve. The elasticity or the demand curve should be clearly defined and used to calculate the surplus of new customers (Florio, 2003, box 3).
- correct indicators (NPV, IRR) (Florio, 2003, section 2.5.5).
- sensitivity analysis for SDR. The presence of the sensitivity for the social discount rate.
- full sensitivity analysis. The presence of the sensitivity analysis for other aspects (Florio, 2003, section 3.3.7).
- time horizon plausible. The temporal extent of the analysis, depending on the characteristics of the projects (Florio, 2003, section 3.3).
- external costs. The presence of environmental and non-environmental externalities (Florio, 2003, section 2.5.2).

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<sup>12</sup> In the table, “yes” means that the element is present or is correct, “no” that it is absent and such absence constitutes a conceptual error, “?” that the answer wasn’t possible due to lack of information. The blank means that the that the issue was not present. For example, in the section “method used” it has been marked “yes” only for the method used.

- continuous in time. If the transitory periods (building phases, etc.) are, correctly, considered.

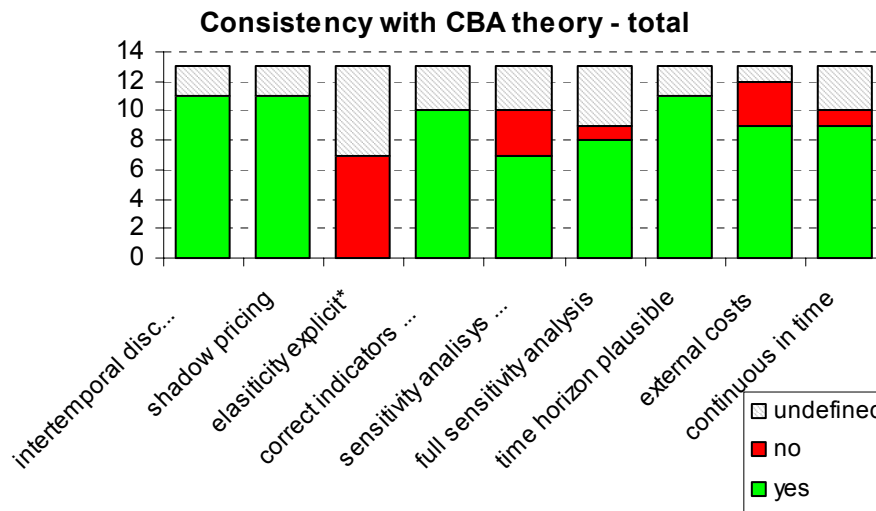


Figure 5: presence and correctness of theoretical aspects of CBA.  
Source: elaboration of the author.

The results are positive. The theoretical foundations are generally respected, even if no project reports the elasticity used for generated traffic and sometimes external costs are neglected (always the case for road projects).

### *Improvements*

Some improvements have been proposed by theory in order to correct some uncovered or failing aspects of standard CBA. These are still not very used in the common practice. The main focuses are the Risk Analysis, the Option Value, the Marginal Opportunity Cost of Public Funds, the use of model integrated CBAs. None of the analysed projects consider these aspects.

### *Theoretical errors*

Some errors have been identified. These are quite general and represent simply the categories of errors found in the survey.

- Double counting. The presence of benefits (or even costs) calculated twice into two different forms. For example: the gains in real estate values due to a transport improvement together with the time gains for the inhabitants.
- Computational errors. In general, all the calculus errors revised.
- Errors in generated traffic benefits. The benefits of generated traffic must be calculated as surplus gain using a quantity(cost) diagram and hypothesising a demand curve. The lack of these elements suggest a wrong benefit, usually calculated as the difference between initial and final costs and multiplied by all the final users. In this case the benefit is overestimated.

- Omissions of some costs or benefits. The lack of some standard and commonly introduced costs or benefits. For example: the lack in the analysis of external environmental costs.
- Consistent benefit calculus (base-project). This refers to the correctness of the base and project scenarios to calculate benefits. For example: it is wrong to calculate benefits as the difference between the project scenario and the year-zero situation, instead of the base case projection to the analysed year.
- Consistent Cost calculus (base-project). See before.
- Use of real alternatives. This is the most common error: the comparison is made of one alternative only or of irrelevant alternatives.

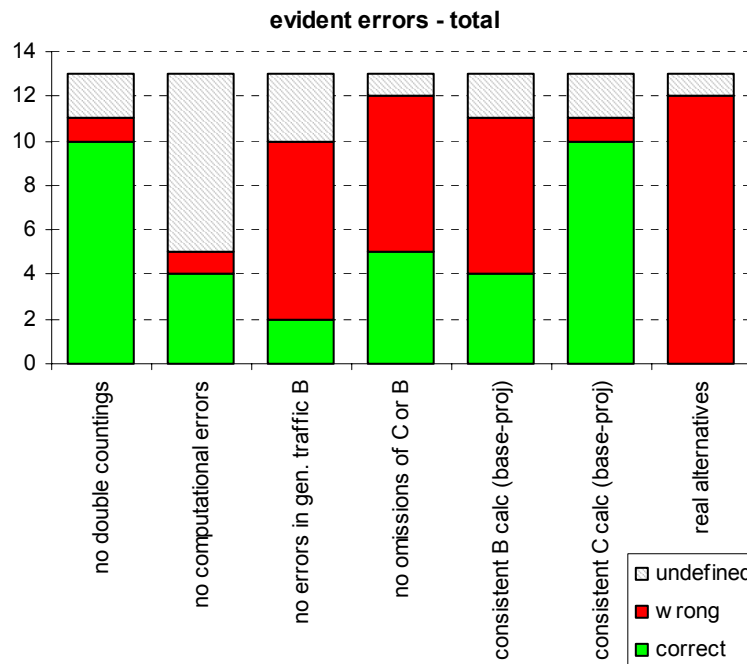


Figure 6: review of the most evident errors revised in CBAs.  
Source: elaboration of the author.

The evaluation of these errors is extremely difficult: the documents provided were often very short and incomplete and the reproduction of the analyses to check errors is sometimes impossible. Although only for a small number of projects the verification is well grounded, some double counting has been found in one project only (*Valtellina* accessibility), such as some minor computational errors (Orte-Falconara rail). The calculation of the costs is generally correct, too. More problems raise in the generated traffic determination, the frequent omission of relevant costs or benefits, and the wrong determination of benefits. For all 12 projects the presence of real alternatives (also where correctly defined in the design part) is, in the author's opinion, absent.

### Data errors

Evaluating this area can be as arduous as those detailed in the previous section. For the sake of simplicity, the answer has been set as positive by default, apart from evident and demonstrable biases. All rail projects used a public source for external costs, but

reported general values even if the specific Italian values were available (see next sections for details). The introduction of errors in data can obviously be accidental, yet despite this, all data used should be justified or quoted. Nevertheless this sometimes does not happen.

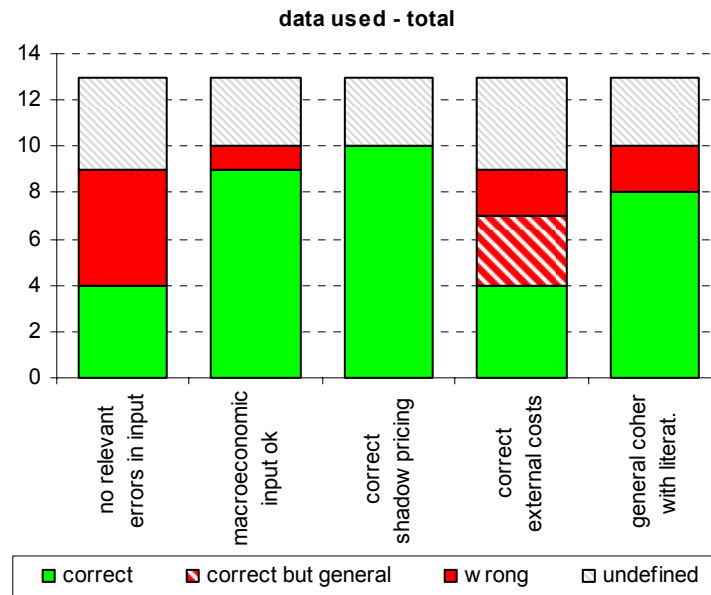


Figure 7: presence of errors in the data used.  
Source: elaboration of the author.

### Clarity and transparency

The data sets used are generally lacking and unclear (only 4 out of 12 projects were clearly explained). The reproducibility of the analyses is generally possible, but this is due to the simplicity of the procedures.

### Results

All the analysed projects are positive according to the produced CBA. For 3 projects the sensitivity analysis points out negative results for some aspects. However, 2 projects are always positive (Modena-Sassuolo link and Verona-Brenner doubling), whatever are the proposed variation of parameters.

Some useful concluding remarks can be made. The CBAs show a good consistency with theory, including almost all the parts of the shared algorithm. The problems appear in the operative parts and in the transparency. Some unacceptable and even evident errors have been found, usually in favour of the project. The alternatives are always irrelevant or absent. Data errors or unclear sources have been revised. The fact that all the projects are positive is, in one aspect, obvious (the alternative is always one), but in another also worrying.

### An example of Cost Benefit Analysis: the RFI standard procedure.

A good example of standardised procedure to Cost Benefit Analysis for infrastructural projects is the one used by RFI<sup>13</sup>. All the rail projects analysed can be classified as “large” projects, involving an average investment of 1.670 M€ (210 M€ of investment for the cheapest project, the Falconara node, and 4.500 M€ for the most expensive, the Brenner Basis Tunnel). For all these large, costly and impacting projects, the only and official document describing CBA is usually about 30 pages long, including the information concerning the demand forecast. An article published in the technical journal of RFI, describes briefly both the theory and an example of such an approach (Cicini et al., 2005). The case study used in the article and described in the following pages is one of the projects previously analysed, the line Orte – Falconara in central Italy. The official documents analysed for this study are exactly the same as the article, apart for some data, sometimes different in the EIA<sup>14</sup>.

The procedure used for all the projects is very simple and procedural. The structure is summarised in the Table 5.

Table 5: structure of CBA in Cicini et al. (2005).

costs	-	benefits
<ul style="list-style-type: none"> <li>▪ incremental costs of investments</li> <li>▪ incremental costs of infrastructure exercise</li> <li>▪ incremental costs of train exercise</li> </ul>		<ul style="list-style-type: none"> <li>▪ reduction of road passengers transport costs</li> <li>▪ time savings for actual demand</li> <li>▪ lower external costs</li> </ul>

Source: Cicini et al. (2005).

Despite the simplicity, which may seem to be excessive for projects of such importance, some aspects of the procedure raise relevant doubts:

- the study states that the new competitiveness of the rail mode comes from the “removal of capacity constraints”, even if these constraints are never demonstrated nor analysed.
- the demand for the infrastructure is never calculated using a model, but “comes from a commercial analysis of the transport operator about the slots it would be interested to buy” (Cicini et al., 2005, page 10). Such analysis is never included in the report nor publicly available, but simply quoted. Moreover, the transport operator is run by the same owner of RFI and this statement is simply a declaration. An independent simulation would be more convincing.

*the quantification of passengers and freights traffic [...] has been done using a “supply side” approach (sic); commercial analyses has been carried out analysing the actual transport demand and defining a new commercially sustainable supply, based on the exercise regime hypothesised after the realisation of projects.*<sup>15</sup>

In practical terms, the method consists in inducting the CBA with a future arbitrary supply and using the same load factors.

<sup>13</sup> RFI is the society, part of the national railways *Ferrovie dello Stato S.p.A.*, owner of the infrastructures and responsible for maintenance and circulation.

<sup>14</sup> details are given later in this section.

<sup>15</sup> Cost Benefit Analysis of Orte-Falconara rail corridor. The same sentences with minimal variations can be found in every RFI CBA. The same CBA can be read as case study on Cicini et al. (2005).



- the general consistency with other projects is doubtful. Projects are analysed singularly, no comprehensive model for all the national projects exists<sup>16</sup>.
- the opportunity cost of public funds is quoted, but not included in the analysis (*cit*, page 12).
- the necessity of realising the scheme completely in order to have the benefits is given as a hypothesis, even if not demonstrated nor realistic. Partial improvements (like selective doublings) can generally give disproportionately good benefits at lower costs (*cit*, page 18).
- part of the surplus generated by new traffic is not considered (the time and money savings due to modal change or the surplus generated by a new displacement).

Moreover, some conceptual errors can be raised:

- benefits are calculated as the difference between the “do-nothing” scenario at year 0 and the one with it at year *n*. A correct approach would consider the difference between the demand at year *n* without the project (“base scenario”) and with it (Florio, 2003).
- no relevant alternatives (i.e. use or improvement of parallel lines) are considered.
- the demand is calculated as purely dependent from supply, using average (and unspecified) load factors. The “commercially sustainable supply” of X trains per day, is multiplied by an average (national?) load factor. This implies an unspecified hypothesis of completely frequency-elastic demand, which is clearly false, especially for rail mode.
- the amount of passenger·km, later used for the determination of all the marginal benefits and costs, is calculated as follows; the average load factor is multiplied by all the train·km produced, as if the train were completely full for the whole journey. The (positive) effect is illustrated in Table 6: the “real” pkm of the example should be 30.000, while the document would report 40.000 pkm. The effect is that the longer the trains’ journeys, the better the CBA result, even if in reality the trains could be even empty.

Table 6: example of pkm calculation in RFI procedure.

<i>stations</i>	<i>A</i>		<i>B</i>		<i>C</i>
Distance		100 km		100 km	
real load factor		100 pax		200 pax	
real pkm		10.000 pkm		20.000 pkm	
assumed load factor <sup>17</sup>		200 pax		200 pax	
assumed pkm		20.000 pkm		20.000 pkm	

Source: elaboration of the author.

Finally, a couple of problems and doubts can be voiced about the data used:

- part of the external costs used, taken from international literature (INFRAS, 2000), are biased. The source reports both the European average and the country specific data. The CBA of article (Cicini et al, 2005) uses the European data, introducing a bias that is in favour of the train system. The data used in the official

<sup>16</sup> Some projects can be considered as alternative to each other: for example the access to alpine passes (Simplon, Frejus and Gotthard) are competing for freights.

<sup>17</sup> The load factors used are extremely high, seeming too similar to peak load factor. See further.

CBA for freight cannot be found in the quoted source. Curiously, with such varying data, the final results of the article and official CBA are identical.

Table 7: External costs used by RFI in the two documents, compared with the quoted source.

	article	Passengers <i>official</i> <i>CBA</i>	INFRAS (Italy)	article	Freight <i>official</i> <i>CBA</i>	INFRAS (Italy)
Road	0.087	0.087	0.078	0.072	0.088	0.072
Rail	0.020	0.020	0.020	0.019	0.004	0.026

Source: Cicini et al. (2005), EIA official documentation, INFRAS (2000).

- the load factors, although extremely important for the estimation of costs and benefits, are never declared. In the article, the load factor for regional trains is 486 passengers/train and for long distance is 375 passengers/train. The values are not explicitly given among the inputs, but they can be simply calculated from the data. It is possible to compare them with the official data published on the operator website ([www.trenitalia.it](http://www.trenitalia.it), visited 07/02/2007). It provides the average number of trains and passengers per day for the regional services of Umbria and Marche. The average regional values (including lines both more and less important) calculated are 189 pax/train and 134 pax/train respectively<sup>18</sup>. The bias introduced with respect to the average regional values is considerable.

## Conclusion

In the paper the framework of the comparative analysis has been defined. A survey of some projects has also been done. Some numerical information has been derived, demonstrating quite clearly the poor quality of produced analyses, given the inadequacy of the EIA tool for the socio-economic evaluation.

The survey pointed out some general patterns concerning the analysed aspects.

- The alternatives, if present, are definitely fictitious, since they aren't incorporated into models and/or in the economic evaluation. The alternatives are generally limited to path variants, no modal or corridor alternatives are considered.
- The base scenarios are seldom correct, with respect to literature and common sense.
- Forecast methodologies are extremely simple, demand and supply relationships appear unexplored, trivial extrapolation of historic data sets prevails. Rail project forecast methodology may be seen as inconsistent.
- Only the road projects provide sufficient traffic data and surveys and analyse it by assignment models. Rail projects ignore actual traffic.
- Lack of use of generic nation-wide models inside the larger agencies.
- Economic Cost Benefit Analysis is the method generally adopted for social feasibility.

<sup>18</sup> *Umbria*: 21000 trips per day using 111 trains. *Marche*: 22256 trips per day using 166 trains. Of course these values are indicative, but gives an indication quite precise of plausible load factors.

- The basic theoretical assumptions of the model are respected, apart from the definition of a demand curve and the consequent welfare gain calculation.
- Many conceptual errors have been found. These errors, generally speaking, introduce a bias in favour of the selected project.
- Some data errors or unjustified values have been found.

The EIA in its original form does not aim to select the most welfare enhancing projects, since the criteria used are different than the ones suggested in this paper. Nevertheless, since no public economic ex-ante evaluation of alternatives is available and the EIA is structured *as if* it were an ex-ante assessment, it would be essential that it is carried out according to a unanimously accepted, transparent and well founded method. An alternative would be to limit the extent of the EIA to only environmental impacts and moving the CBA to a former phase, where the alternatives are still present and different choices remain possible.

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