



**European Commission**

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**EUROMED TRANSPORT INFRASTRUCTURE NETWORK PROJECT**

**INTRODUCTION TO TRANSPORT FEASIBILITY STUDIES**

**28<sup>TH</sup> JUNE TO 1<sup>ST</sup> JULY 2005**

**SESSION 3**

**PROJECT DEFINITION AND TECHNICAL APPRAISAL**

**JOHN SNELL**



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**1. INTERACTIVE ENGINEERING**

- 1.1 Over the last 30 years, the philosophy of the preparation of major infrastructure projects has undergone profound change. Into the 1970s, the engineering design of a power station or the modernisation of a railway system was conducted as essentially a technical exercise --- safe design was paramount and any obvious extravagance was unlikely to get past the engineering manager but often there was no systematic consideration of costs versus benefits and little, if any, consideration of the feelings of taxpayers who would hear, see and possibly smell the project when it was built and while it was being built. Today, the preparation of a major project has become much more transparent and democratic. The taxpayers have got organised and the scale and output of the object being built will be subject to a rigorous consideration of its economic performance (benefits compared against costs), as well as its environmental impact.
- 1.2 The production of a "good" project depends on the interaction between three basic disciplines: in English these are ***Engineering, Economic Evaluation and Environmental Assessment*** --- ***the 3 "E's"*** (Fig. 3.1). Historically, "Engineering" has been the lead partner as public projects often originate with politicians, who turned to engineers that they know to make a concept look like something that could be built. The influence of economists and environmentalists (the latter usually joined by the taxpayers) has grown in the western countries since the early 1970s until today there is a three-way partnership between the disciplines. The necessary interaction between these three disciplines to produce a "bankable project" is a theme that runs throughout this Course.
- 1.3 The development of a project is an iterative process (Fig. 3.2). The initial engineering concept or design produces cost estimates that are a basic input to the economic evaluation and the technical parameters of the initial design are an input to the calculation of benefits. A few circuits of the 'engineering>economics>engineering' loop will begin to refine the project. But, parallel to this, the environmental members of the design team must be looking at



the initial design. It is essential to incorporate the environmental inputs at an early stage: the later these inputs are obtained, the greater the risk that opportunities will be missed to include positive environmental features and the greater the risk that negative impacts will not be identified. Finding that the developing scheme has some unacceptable features can usually only be cured by increasing the cost - when this is run through the 'engineering>economics' loop again, the scheme falls below certain cost-benefit thresholds, so there is another iteration of the 'environment>engineering' loop to find a compromise acceptable to all disciplines. With strong management (usually the engineering partner), this iterative process produces a project design that meets most criteria. However, with poor technical management, the key disciplines proceed along separate but parallel paths that ultimately have to be reconciled, introducing delay and forced compromises. In these circumstances, project quality takes a nose-dive.

## 2. THE PLAYERS

2.1 You have an inter-urban motorway in the early stages of design and the decision has been taken to supplement the revenue available from the national budget or the Road Fund with a loan from one of the international development banks.

These, then, are the institutional "players" (Fig. 3.3):

- the **Borrower**: most probably the Ministry of Finance but may be the Ministry of Transport
- the **Beneficiary**: this is usually the Ministry of Transport but, if that body is the Borrower, implementation will be delegated to the Roads Administration. For convenience, either party may be known as the project 'Sponsor'
- the **Bank** (or Lender) or Donor: the multi-lateral banks are known collectively as the International Financial Institutions (IFI's) but the source of funding may be a donor, such as the European Union (EU) or the International Development Agency (IDA) of the World Bank.

2.2 The assumed starting point for this Course is that the Borrower or Beneficiary has had preliminary contact with a bank or donor and both parties have agreed a mutual interest in carrying out a project, which will usually have several components. The design of the components has usually been defined at a conceptual level through pre-feasibility studies already undertaken, either through local resources or with external assistance. The objective of this Course is to



explain the steps and processes that the Sponsor will undertake in order to convince the Lender/Donor that each component is well conceived in the national and local context, is likely to bring worthwhile economic and social benefits and that it complies with the environmental legislation of the Sponsor's country and of the Lender/Donor. The project Sponsor has to demonstrate rigorously that a project and its component parts meet all the Bank's or Donor's criteria regarding project objectives, affordability, analysis of alternatives, economic viability, social and natural impacts.

2.3 In appraising a project, an IFI or Donor is likely to find components that are in various stages of readiness to be tendered. Components that are fully designed and have all necessary permits can, in theory, be tendered very soon after the loan is signed and disbursement could therefore start early in the project implementation cycle --- this is in the interests of both parties. However, the Sponsor has to demonstrate the engineering, economic and environmental "soundness" of such fully-developed components. Components that are at a conceptual stage will be taken into the project scope on the basis of the level of information available at the time, a judgement being taken whether they can be fully developed, with characteristics acceptable to the Bank/Donor, and are able to go to tender later in the project cycle. These components will often require some external assistance for their proper preparation and these circumstances give the opportunity for technology transfer to local firms and organisations. Also, they give a Bank or Donor the opportunity to have a greater impact on the institutional ability and practices of the Sponsor.

2.4 A typical infrastructure project that is funded by one of the IFI's will have three categories of components in its scope: **Works**, the construction of an inter-urban motorway, in our case; **Goods**, such as snow-ploughs to keep it open to traffic; and **Services**, usually to pay for consultants or training (who may advise on the opportunities to toll the motorway, for instance). Some IFI's do not look very favourably on projects that are simply composed of Works.

### 3.1 "Preferred Scheme"

The term "*Preferred Scheme*" is taken from highways practice in the United Kingdom but is a concept applicable to international projects. The *Preferred Scheme* means the overall design that has been developed in accordance with



contemporary good practice of the "3 E's", which has incorporated public comment and which the project Sponsor wants to build. The term indicates that options or alternatives have been investigated but that this is the solution that is *preferred* against all others as being value for money and in the wider best interests of the country and the locality. The *Preferred Scheme* embraces all aspects of the proposal --- the works constructed within and outside the right-of-way, the economic performance, positive and negative effects upon the natural environment and any social changes that arise, such as re-housing.

### 3.2 The Assessment Framework

This flow chart (Fig. 3.4) is also taken from UK practice but has a wider application. This Session will discuss the operations on this chart and how they are integrated to deliver a scheme that is well prepared and "robust" in the eyes of a potential Lender or Donor (later sessions will look in detail at the economic evaluation and environmental assessment). An *ASSESSMENT FRAMEWORK* is a tabulation of the leading characteristics of the *Preferred Scheme* in comparison with the characteristics of the highest ranking alternatives that have been evaluated (there will usually be at least two other alternatives). The *FRAMEWORK* is the "tool" given by the engineers to the politicians to support the selection of the Preferred Scheme.

### 3.3 Traffic Study

The economic evaluation of alternatives depends primarily on the total costs of the scheme (not merely the cost of construction) and the costs and benefits attributable to vehicles travelling on all the roads in the traffic study area. This produces a definition of the study area for design and economic purposes --- it should include all roads on which building the scheme causes a significant change in the traffic flow. A computer model of the traffic network is invariably used to handle the large amounts of data involved. The accuracy of the estimation of traffic flows in future years will depend on the data and resources available, ranging from simple growth factors to more complex calculations based on the forecasting of economic activity (these topics are covered more fully in Session 4). The traffic flow and the economic performance of the project are normally calculated for the duration of the loan, that is, up to the date of final repayment of principal. Typically, this repayment period will be 15 years for transport projects



although the forecast period for the traffic study is usually in the range 20 to 30 years.

### 3.4 Planning Policies

In the present context, the relevant planning policies are those concerning national and regional aspects of transport in general and development, and economic issues. These topics feed directly into the *FRAMEWORK* box. Planning issues such as land-use zoning can have a significant constraint on alternative alignments, as can environmental policies such as the need to avoid a sensitive protected area. A policy, for example, to stimulate exceptional manufacturing growth in a particular zone might be reflected in the economic evaluation.

### 3.5 Alternatives

3.5.1 Highways schemes often have a very long gestation period --- sometimes as much as 40 years from an initial proposal to the time of construction. The usual terminology is that *corridors*, possibly of radically different concept or alignment, are evaluated at the pre-feasibility stage. This screening of 'broad brush' options will (or should) remove from the analysis all the wilder options, sometimes introduced for political reasons. Proceeding to the feasibility stage (the present case), the options to be studied become *alternatives* within the preferred corridor (or corridors).

3.5.2 As previously mentioned, the key to the design of a successful project is the management of the interaction that has to take place between the engineering and the economic and the environmental analyses. The other "dimension" of this process that has to be carefully controlled is the number of alternatives that are studied at the feasibility stage. Ideally, the pre-feasibility stage will have identified one corridor and a preferred scheme can then be refined from a small number of alternatives within the chosen corridor. In reality, matters are not always as clear cut and two (or more) corridors may still be under study at the start of the feasibility stage. Most international banks would not be sympathetic to a Sponsor who offers a feasibility study of only one alternative (that is, the *Preferred Scheme*) and delay then may arise from the need to look at more alternatives. Three feasible alternatives, that is, two schemes in addition to the *Preferred Scheme*, should be presented, with an absolute minimum of the



Preferred Scheme plus one other. At the other extreme, a large project that can sensibly be divided into two or more components (possibly with phased construction) can give rise to an unavoidably higher number of alternatives arising from the combination of alternatives within each phase: in any event, it is strongly recommended that the maximum number of 'Do-Something' alternatives should not exceed six.

3.5.2 As will be discussed later in this Course, a feasibility study must also include the 'Do-Minimum' alternative, which is the base case against which all the 'Do-Something' or 'with scheme' alternatives are compared for economic and environmental purposes. 'Do-Minimum' should not be confused with the term 'Do-Nothing', which is a term often loosely but incorrectly applied to the 'without scheme' situation. The Do-Minimum costs represent the essential expenditure still necessary without the scheme being built. An example is the repair of roads and streets within a town that is bypassed by the motorway --- these costs will be reduced with the reduction of traffic but cannot be ignored. Similarly, Do-minimum benefits arising from quicker journeys within the bypassed town have to be included in the economic equation. The Do-Minimum case should also include nearby major road schemes that will be built whether or not the motorway is built.

3.5.3 The number of 'Do-Something' alternatives to be studied may also increase due to matters arising from the introduction of varying design standards (indeed, a feasibility study can, exceptionally, consist of the selection of the appropriate cross-section of a highway along a known alignment). In the normal case, the standards of engineering design applied to the alternatives under consideration need to be appropriate in two main respects. Firstly, they should be appropriate to the forecast traffic (usually that estimated for the end of the evaluation period). A Sponsor may prefer to have grade-separated junctions but there is unlikely to be an economic justification for this at traffic levels below 10,000 vehicles per day. Secondly, the design standard may not be identical for all alternatives but should be appropriate to the characteristics (primarily, the level of traffic) of the alternative. For example, if only one of several 4-lane alternatives has a connection to an existing major road at a point, say, 5km from the southern end of the motorway, it may only be necessary to provide 2 lanes on the motorway to the south of that connection.



### 3.6 Consultations

3.6.1 The principal external source that shapes a project is public opinion, which is gathered through consultation. In best practice, this is achieved at three levels --- during the evolution of alternatives, during the collection of data regarding the alternatives and, finally, to measure public reaction to the "preferred alternatives" that are compared in the *ASSESSMENT FRAMEWORK*. Parallel to these specific tasks, dialogue should take place with affected groups and individuals. The day-to-day management of consultation is the responsibility of the environmental members of the project team: the sensitivity and professionalism with which it is carried out determines the public perception of the project and, if these qualities are lacking, public resistance to the project may assert itself in a democratic society. Consultation represents both a vital input and a vital output in terms of public relations.

3.6.2 In most countries today there are branches of the major environmental 'non-governmental organisations' (NGO's), such as 'Greenpeace'. These organisations should be included into the consultation process at an early stage, indeed, not to do so runs the risk of creating resistance to the development of the project. When engaged, NGO's are often a convenient source of data and information, and may even contribute to carrying out necessary surveys. Where the structure of society within the study area is still influenced by a centrally-planned economy, consultation at a 'grass roots' level may be seen by a project Sponsor as unnecessary, a view that may not be shared by the funding agency. At a bare minimum, consultation must take place at an institutional level, that is, including relevant elected organisations such as district councils.

### 3.7 Typical Assessment Frameworks

The information that is collected in order to "fill" each of the boxes in the flow chart (Fig. 3.4) can be summarised in several ways. One style of presentation is shown in Figure 3.5, taken from the example of the Dunstable Bypass in the UK. Summary sheets of the type shown are prepared to show the effect of the proposed scheme upon all "travellers" (including groups such as cyclists and pedestrians), upon all "occupiers" (as shown in the present example for occupiers of residential property, with similar sheets for industrial and commercial properties), and for the effects upon farming, recreational facilities and cultural



life. This type of presentation, although it is a summary, can, in the case of a major highway scheme, run to a large number of pages (20 pages in the case of Dunstable). Therefore, a more concise style of presentation has been developed, as shown in Figure 3.6, where the *preferred scheme* characteristics are condensed to one page and there would be a similar one-page presentation for each of the assessed alternatives.

#### 4. TECHNICAL COOPERATION

- 4.1 The international banks expect the Borrower to pay part, at least, of the costs of preparation --- this is seen as a token of serious intent that the Borrower (or Sponsor) is prepared to commit resources. As an indication of the scale of these expenses, in the UK the *total* costs of project preparation are typically around 9 percent of the costs of construction and land and about one-half of this figure is spent up to the point of identifying the preferred scheme, the other one-half covering (approximately) the costs of producing tender documents and the supervision of construction. Similar costs on a major project can be a major item in the budget of a Sponsor.
- 4.2 Both the Lender and the Borrower have an interest in ensuring that a project is properly designed --- most of the notable delays in starting physical construction can be traced back to poor design (in the broadest sense, not specifically the technical design of the road). The IFI's and the international donor community recognise their involvement as the means of improving the overall quality of projects (by technology transfer) and, accordingly, there is widespread grant aid available to assist in project preparation. These funds are either 'free standing', such as the PHARE and Tacis technical assistance programmes, or are in the form of bilateral aid which is tied to assistance being provided by experts of the donor country. In either case, the Bank/Donor working on your project will help in securing such grant money, primarily by contributing in the preparation of Terms of Reference and in the selection of consultants; often, the Bank/Donor will handle the administration of payment for services. Being aware of the financial problem posed by the need to employ foreign consultants, some agencies make available "pre-investment" loans to cover these front-end costs, in which case, repayment is rolled-over into repayment of the investment loan.



- 4.3 The need to employ foreign consultants should be investigated and acknowledged as soon as possible in the project cycle, as the bureaucracy of obtaining funding and selecting a consultant is a potential cause of delay.

# MEDITERRANEAN TRANSPORT INFRASTRUCTURE NETWORK PROJECT (MTIN)

## SESSION 3: PROJECT DEFINITION AND TECHNICAL APPRAISAL

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MEDA Transport Infrastructure Network Project



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## THE 3 E'S

FIGURE 3.1

- E for Engineering
- E for Economic Evaluation
- E for Environmental Assessment



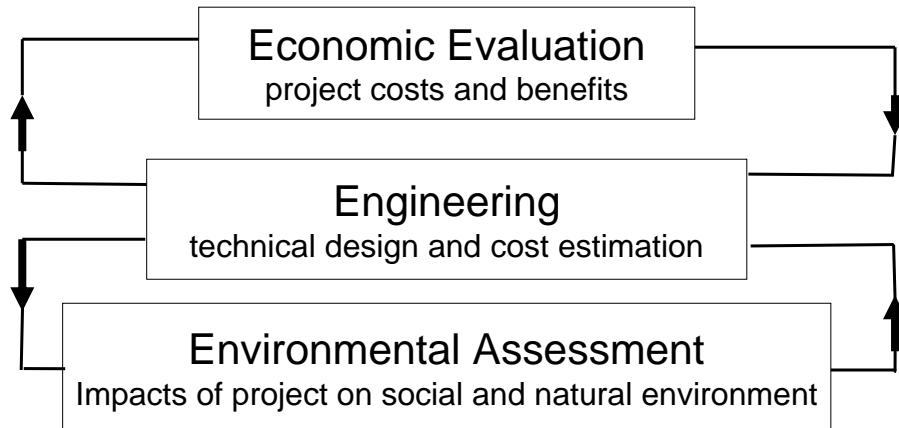
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## LINKS BETWEEN THE 3 E'S

FIGURE 3.2



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## THE THREE B'S

FIGURE 3.3

- The Borrower: almost certainly the Ministry of Finance
- The Beneficiary: for the legal purposes of the loan, this is usually the Ministry of Transport, although implementation is often delegated to the Roads Administration. Either party may be known as the project 'Sponsor'
- The Bank or Lender: collectively, the multi-lateral banks are known as the International Financial Institutions (IFI's)



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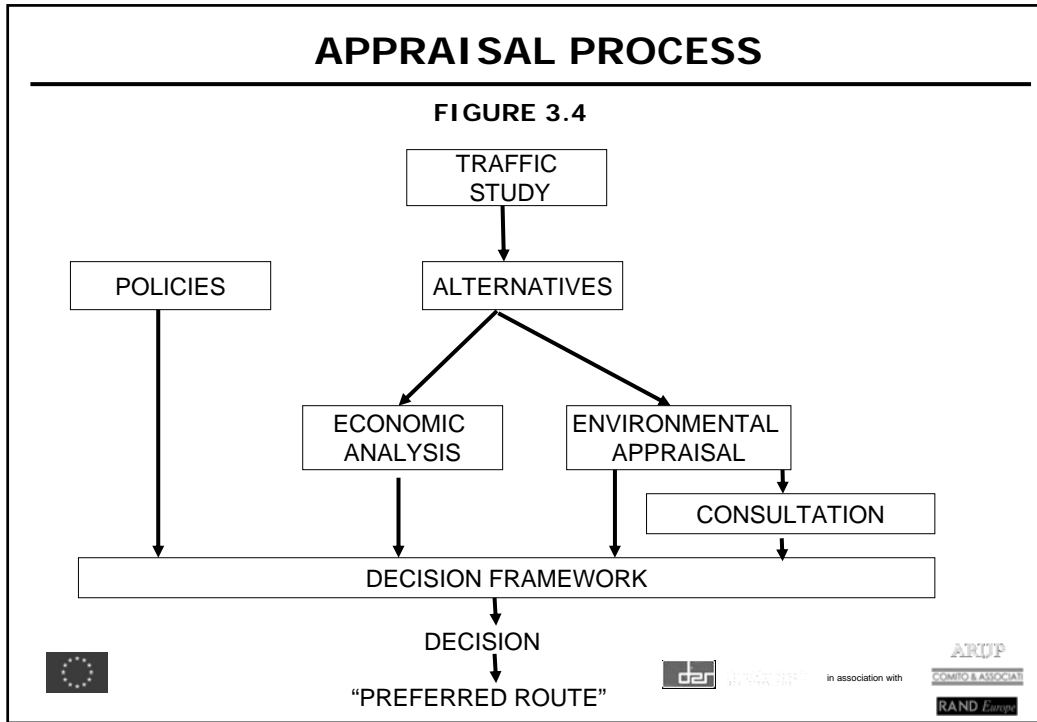


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# APPRAISAL PROCESS

FIGURE 3.4



SubGroup	Effect	Unit	OPTION A	Eastern Route OPTION B	OPTION C	Western Route (rejected)	WEST:EAS T(rejected)	Do- Mini mum	Comments
Residential	Properties demolished	Number	0	0	0	10	5	0	
	Gardens affected	Number	0	3	3	22	8	0	
	Noise effects adjacent to new road	Number of houses within 300m of centre-line 0-50m 50-100m 100-200m 200-300m	75 325 625 675	As Option A	As Option A	100 225 525 475	100 350 800 1100	400	Do-minimum entry show number of houses from the existing route. Figures given to nearest 25
	Noise effects adjacent to existing roads	Number of houses experiencing at least a halving of the present traffic	200	150	225	50	275	None	A halving of traffic flow indicates approximately 5dB(A) L10 (18 hours noise reduction). Figures given to nearest 25
	Visual obstruction		High for Station Road	High for Station Road and part Douglas Crescent	As Option B	Slight	High for A5 crossing area and Station Road	None	
	Visual intrusion		Moderate at Blow's Down	As Option A	As Option A	High north of Sewell Lane and at Green Lane	High North of Sewell Lane, moderate at Blow's Down	None	
	Severance		Slight	Slight	Slight	Moderate	Slight	None	
	Disruption during construction	Number of houses affected	6 on A5120 15 on A505	6 on A5120	As Option B	Approx 70 at B489/Whipsnade Road Junction	2 on Sewell Lane	None	

Appraisal Summary Table

FIGURE 3.5

A41 Aston Clinton (GOSE)		1996 Scheme – 6.4km D2 Bypass		Cost: £ 21m	
PROBLEMS		23,000 vpd pass through Aston Clinton village (pop. 2,600,360 properties fronting existing road) resulting in a poor safety record, severance and environmental degradation. Expansion of Aylesbury particularly new housing will increase traffic through village.			
OTHER OPTIONS		Rail improvements, such as CrossRail, would have minimal effect due to diverse trip patterns. Single carriageway bypass considered - it would have longer journey times because of longer alignment than existing road, so would not attract as much traffic from village.			
CRITERIA	SUB-CRITERIA	QUALITATIVE IMPACTS		QUANTITATIVE MEASURE	ASSESSMENT
ENVIRONMENTAL IMPACT CO <sub>2</sub> tonnes added 0-2000	Noise	Benefit from the removal of through traffic from the centre of Aston Clinton, but the bypass would lie closer than the existing road to some outlying properties at each end and near Drayton Beauchamp.		No. properties experiencing (w/s): - Increase in noise 1 - Decrease in noise 154	net 153 properties win with scheme
	Local air quality	Scheme would remove through traffic from the centre of Aston Clinton.		No. properties experiencing: - improved air quality 267 - worse air quality 0	-205 PM <sub>10</sub> -1254 NO <sub>2</sub>
	Landscape	Highly intrusive within Chilterns AONB			Moderate -ve
	Biodiversity	Partial loss of species-rich meadows of local importance + several ancient hedgerows.			Slight -ve
	Heritage	Severe impact on moated site, one of best preserved in County, & its very significant environmental evidence.			Large -ve
	Water	Assuming effective mitigation to reduce pollution risk and the impact on land drainage, risk of damage to the water environment is likely to be slight.			Slight -ve
SAFETY	—	Number of frontages and side roads accessing A41, some with limited vision, leads to most accidents.		Accidents Deaths Serious Slight 440 8 140 430	PVB £6.3m 43% of PVC
ECONOMY	Journey times & VOCs	—		peak inter-peak 5.7 mins 4.4 mins	PVB £38m 300% of PVC
	Cost	—		—	PVC £14m
	Reliability	—		Route stress Before 94% After 19%	Slight Low rel to PVC
	Regeneration	—		Serves regeneration area?	NO
ACCESSIBILITY	Public transport	Would improve bus reliability.		-	Slight+ve
	Severance	Reduces severance in Aston Clinton (70% reduction in traffic), with 1 opportunity for traffic calming to improve conditions in the town centre following traffic reduction..		-	Moderate+ve
	Pedestrians and others	Improves accessibility to key village facilities for pedestrians and cyclists.		-	Moderate+ve
INTEGRATION		Integrates with Berkhamsted and Kings Langley Bypasses (opened 1993). Scheme consistent with local plan. Facilitates Structure Plan housing proposals in Aylesbury.		-	Positive
COBA		<b>FIGURE 3.6</b>		PVB £44m PVC £14m NPV£29m BCR3.0	