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**ECONOMIC COMMISSION FOR EUROPE**

**INLAND TRANSPORT COMMITTEE**

Working Party on Transport Trends and Economics  
(Sixteenth session, 24-26 September 2003,  
agenda item 5 (b))

**EVALUATION OF INLAND TRANSPORT INFRASTRUCTURE PROJECTS**

**PHASED APPROACH TO TRANSPORT INFRASTRUCTURE DEVELOPMENTS**

**REFLECTIONS BASED ON THE EVALUATION OF TRANSPORT PROJECTS AT  
THE EUROPEAN INVESTMENT BANK**  
(revised September 2003)

Transmitted by the European Investment Bank (EIB)

Note: Following the request by the Working Party on Transport Trends and Economics, at its fifteenth session (TRANS/WP.5/32, para. 28), the secretariat approached a number of member countries as well as international organizations in order to collect the available methodologies on a phased approach to transport infrastructure developments. The reply received by the European Investment Bank (EIB) is reproduced below.

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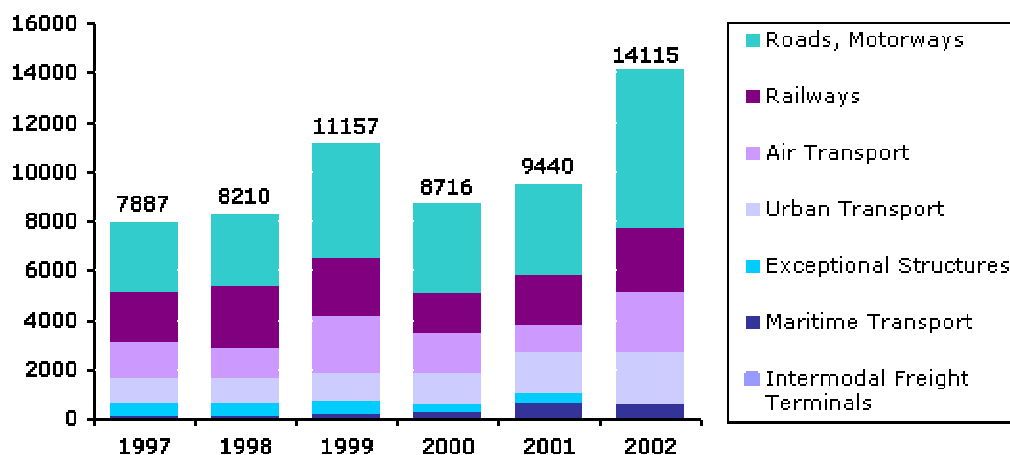
## 1. Background<sup>1</sup>

The European Investment Bank (EIB), based in Luxembourg, is the lending institution of the European Union. It is owned by the EU member countries, from 2004 on the ten new member states will be among its owners. Country representatives sit on the Board of Directors, which approves the main policy lines and the individual loans. The main purpose of the EIB is to finance projects of common interest through the provision of long-term loans. Broadly, a project must further a European Union economic policy objective, assist the preparation of candidate countries for EU membership, or contribute to the EU's external partnership and development assistance policies to be eligible for EIB co-financing.

EIB provides service and value-added, through its project appraisal of economic, technical, environmental and financial conditions. One important focus of the EIB is loans with maturities adapted to the specific needs of infrastructure projects, where the Bank provides complementarity to other funding sources. In general, the Bank does not finance beyond 50% of the project investment cost. Yet it often has a catalyst's role and provides critical support for structuring the finance of major projects, and promotes public-private partnerships (PPP) where appropriate.

The EIB has become the major international financial institution (IFI) in the field of transport infrastructure financing. In 2002 transport sector loans totalling 14.1 billion EURO were signed, 18% of which were given to projects outside the EU, mostly to Accession countries, the Mediterranean and Balkan region. Figure 1 indicates the loan distribution in the various sub-sectors.

Figure 1. EIB activity in the transport sector in the EU (in million EURO, current)



<sup>1</sup> Paper by Mr. Claus Eberhard, Economist in the Road & Rail Division within the Projects Directorate of the European Investment Bank. The paper is based on his personal experience in transport project evaluation in the EIB, but does not reflect, in any way, an official position of the Bank.

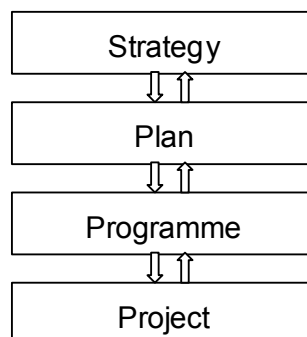
The EIB plays an essential role in the financing of most major transport projects in Europe, in particular for the trans-European transport networks (TEN-T) and the development of pan-European corridors for transport. The EIB has contributed to finance, on average, 30% and 40% respectively of project costs, across all transport modes.

The Projects Directorate of the EIB carries out a thorough evaluation of the projects requesting finance in order to support only those responding to its eligibility criteria – such as contribution to regional development or improvement of the trans-European networks - and to rigorous quality requirements. The paper will focus on transport infrastructure, which represents more than 40% of all individual EIB loans.

## 2. Phasing – a wider context

There are several ways to look at phasing. In a sense, phasing is common in most sectors, and typical for transport investments: Transport projects are generally parts of larger strategies covering several transport modes, translated into development plans. The assessment and prioritization of a large number of potential projects, and available budgets, lead to investment programmes consisting of the individual projects, to be implemented in a phased manner over time.

Figure 2. Planning hierarchy



Not only budgetary constraints, but also the available planning, administrative and construction sector capacities suggest a careful phasing of the investment over time and space. Prioritization and selection processes are necessary in order to invest where the rewards in terms of benefits related to cost are greatest. At the same time, implicitly, the demand arises to not to over-specify project designs, thus allowing to make the most efficient use of available funds. This leads to phasing in a narrow sense, which is the adaptation of design and capacity parameters of a specific project over time.

Hence, phasing can be considered in two dimensions, spatial and temporal. Spatial phasing is the selection and (temporal) prioritization of projects out of an investment programme. Temporal phasing is then the staggered provision of infrastructure specifications of a specific project, such that capacity levels harmonise supply with traffic demand rising over time.

Phasing is usually, and in the remainder of this paper, analysed against the framework of classic

valuation theory, deriving net present values (NPV) of an investment and/or rates of return. Expected cash flows are used, representing costs and benefits. Future cash flows are discounted to take account of uncertainty. Timing is important, as the present value of cash flows depends on their temporal location within a project life cycle. Risk is translated into higher discount rates, containing a risk premium.

This classic approach, however, ignores one possibly important aspect, which is the real option value of phasing an investment. The idea is not unknown in the field of transport: Option values, i.e. the value of having a range of options to choose from, can be observed and proven for example for offering modal choice options. According to real option theory, first presented by Black and Scholes in 1973, several aspects of an investment can or should be evaluated and accordingly valued, describing investments as a real dynamic decision process and explicitly taking into account decision nodes in the future. Opportunities over time, their costs and benefits are assessed. The waiting-to-invest option (i.e. the possibility to wait with an investment until more information is available, leading to a better-funded decision), the growth option (which deals with secondary effects stemming from an investment), the flexibility option (e.g. designing projects to support flexible adaptation of capacities to demand), an exit option (considering the abandoning of a project during implementation) and a learning option should be considered when developing project investment plans. It should be a worthwhile challenge to apply the existing theoretical framework of the real options theory to the transport sector, broadening the scope of current phasing discussions.

### **3. Bank's role in phasing**

The development of a transport strategy, plans, the set-up of an investment programme and the selection and temporal prioritization of transport investment projects is within the domain of individual countries, regions, districts, municipalities etc. Within countries, there may be several layers of planning and decision-making, and differing degrees of private sector involvement, for example in the form of motorway concession companies or privatised railway companies.

Financial institutions like the EIB nearly always enter only after the (political) intention to build a certain piece of infrastructure is clear, at a stage when financing options are explored. A design may or may not have been already decided on.

If becoming involved at a very late stage ("the men with the shovels already waiting"), there is a risk that the EIB will have to decline to participate in the co-financing of the project. Procurement is an important issue; the EIB has to insist that EU rules and directives are adhered to, usually requiring international tendering. Another prerequisite is the strict compliance with EU's environmental legislation, prescribing Environmental Impact Assessments for many transport projects. Furthermore, the Bank needs to be assured that a project is economically viable. Temporal phasing may defer part of the project investment cost to a later point in time, thus increasing the economic rate of return of a project. When involving financial institutions like the EIB at an earlier stage, for example at the stages of programming the projects within an investment programme, it is usually possible to check whether a given project satisfies the EIB criteria, and to eventually redesign or re-phase the project such as to make it bankable and determine the optimal timing of the investment.

Financial institutions do not have a role in setting up transport development plans, or in the selection and prioritization of projects. However, specialised banks like the EIB have built up a rich knowledge in transport project evaluation. With decades of experience following the implementation of transport policies and investment plans, the EIB may add value in an optimization of project design, implementation and phasing. Some critical issues are presented in the following sections.

#### **4. Transport Project Evaluation Methodology**

The prerequisite for sound investment decisions, including the phasing of projects, is the existence and application of evaluation tools. The standard economic evaluation procedure used in the EIB for most transport projects is cost/benefit analysis (CBA). For road infrastructure investments, a well-adapted spreadsheet model is used comparable to the HDM models of the World Bank. The cost estimates of the promoter are taken as basis of investment costs, although the EIB may add technical contingencies and other potentially missing cost elements. Operating and maintenance costs rely either on the promoter's figures or on Bank estimates drawing on past experiences with similar projects. User benefits are limited, in general, to travel time savings, reductions in vehicle operation costs (VOCs), safety improvements and - where appropriate - some quantified environmental impacts. A sensitivity analysis is part of the exercise.

The result of the analysis is normally presented in terms of an Economic Rate of Return (ERR) and of a Net Present Value (NPV). For revenue-generating projects, such as toll roads or railway projects, a Financial Rate of Return (FIRR) is generated in addition. A "minimum profitability" approach works well in most circumstances. This approach is suited to the needs of the Bank: It tends to be conservative and easy to communicate to other Bank services (e.g. Operations or Credit Risk Directions), to its Management Committee, and to its Board of Administrators. The main objective of the evaluation is to ascertain whether a project is economically justified or not. Compared to decision-makers who have to prioritise projects within investment programmes, a precise profitability estimate is less important to the Bank .

From EIB's point of view, a project must have a reasonable design and a reasonable economic justification. A violation of EU's environmental standards is not acceptable and leads to the rejection of a project, if the design cannot be improved to fulfil the environmental standards. The technical specification is usually derived from traffic forecasts (which are scrutinized closely, namely in the case of tolled roads), with traffic levels achieved in 10-15 years being used to check reasonable design parameters, namely the number of lanes (tracks) as crucial determinant for road (rail) capacity. One important element not to be neglected is the design speed of a road or railway: Especially in areas with difficult topography, the use of a lower design speed along certain sections can lead to large cost reductions. This has been recognized as well in the "TEM Standards and Recommended Practice" for motorway construction.

If a proposed project does not deliver an acceptable economic rate of return in its proposed form, possibilities for improvement are looked for by the EIB. A more detailed CBA is performed, for example exploring network effects. The potential for scaled down or phased project implementation is assessed with a view to reducing the cost base and improving profitability. When incremental project implementation is considered, rate of return calculations are performed for each reasonable project version, and marginal rates of return of switching

from one stage to the consecutive are computed. Within the limits of data and information made available by the promoter to EIB, the aim is to find the optimal project configuration.

## **5. Critical questions in transport project evaluations**

The use of cost/benefit analysis (CBA) for the evaluation of transport investments has its limitations. The EIB is aware of these, CBA models do not always respond well to the requirements of present day decision-making. Some of the identified problem areas are the selection of the reference case, cost definitions (resource vs. market values), the quantification of user benefits, and the reliability of demand forecasts. For the problem of evaluation of transport externalities, including climate change issues, there is still no generally accepted consensus.

More complex procedures, such as multi-criteria analyses, have been proposed and applied for the evaluation of transport projects. Sometimes, effects that are difficult to monetarize (regional development, equality of living conditions, ) are, depending on their significance, converted into multiplicative or additive factors which are then applied to CBA coefficients of projects, potentially reshuffling their prioritization.

However, there is a widespread agreement there are common determinants, such as time savings, operation cost, accidents and environmental impact, which can explain the bulk of benefits and disbenefits stemming from a project. Cost/benefit analysis can usefully be applied to screen a large number of projects. Applying a common set of variables and valuations, a ranking of projects according to their benefit-cost ratios becomes possible. Furthermore, the same CBA procedure can be applied to assess phasing variants of projects.

## **6. Practical problems of temporal project phasing**

A temporally phased approach has many charms in theory, however faces problems in practice. Despite some shortcomings, economic issues can satisfactorily be assessed with standardised and widely accepted cost-benefit methods and models over a life cycle of, say, 30 years for a road project. Some deficits however exist concerning the treatment and valuation of the extra project cost and disbenefits to users arising from the necessity to implement later phases of a project while traffic is continuing.

More difficult to capture, however perhaps equally decisive, are issues related to the actors – politicians, the planning authorities and decision making bodies, the promoter/operator, users benefiting from improved infrastructure vs. others who are left out when channelling funds to a small number of projects, (un)willing neighbours of new infrastructure, NGOs and interest groups – are likely to have different views about phasing of projects. Warming-up and cooling-down costs have to be considered when a project is implemented in phases. This applies as well to public-private partnership (PPP) projects, where transaction cost are one of the reasons to implement a project in a single phase.

## 7. Practical relevance of project phasing

There are no formal statistics of phasing of projects maintained at EIB, as their usefulness would be rather limited. Promoters (or their consultants) who have once worked with EIB tend to make sure to submit reasonable projects, often exploiting phasing opportunities.

In many infrastructure sectors, phasing of investment is the standard practise. Industrial plants, energy production, water works and sewerage facilities are designed to be built in phases, or at least to leave room for future expansion. In the field of transport, projects such as ports and airports are usually built that way.

In urban transportation systems, phasing often involves rolling stock and the operation mode: For a given line or network, provisions are made that the service frequency can be increased when demand rises, requiring additional rolling stock and at some stage changes in the operating system from manual to automated forms. The spatial form of phasing, the incremental development of networks is self-explanatory.

A railway project can as well be phased. Over time, railway lines have become electrified, double-tracked, equipped with signalling and safety systems to cope with rising demand – or operation has been simplified, lines de-electrified and single-tracked, and permitted speeds lowered, to adjust cost to falling demands and changing market conditions. In recent EIB railway line rehabilitation projects, provisions were made to cater for rolling stock improvements (e.g. tilt trains) allowing for further improvement of services in future phases.

In some special cases, “multimodal phasing” is applied: The 117 km long “rolling motorway” railway shuttle service between Dresden and Lovosice was introduced (and is receiving subsidies) as a temporary measure to be able to quickly cope with growing transport demand along a corridor forming a bottleneck. Once sufficient road capacity is available in the form of a motorway currently under construction, the service will (probably) be abandoned.

Spatial phasing, i.e. the programming of projects over time is common and supported by the EIB: From many countries, there are road projects presented to and co-financed by EIB (almost) annually. Unlike with some public budgets, including EU subsidies, there is no need to hunt for money that might not be available in the following year.

A frequent option for temporal phasing of road projects is the construction of a semi-motorway as a first phase to a full motorway, or the construction of a 2x2 motorway with preparations for a future extension to 2x3 lanes. Often such solutions are presented by the promoter, but there are cases where the EIB – which may be more conservative than a promoter concerning traffic forecasts (especially in the presence of tolls) and outturn cost – has to demand a reduced initial project scale as condition for the loan on grounds of insufficient economic returns for the project as originally by the promoter. Nevertheless, the first phase includes the necessary provisions for capacity extension in a following phase, e.g. land reservation and design of structures in order to accommodate additional lanes in future.

To give but two examples: In a road project, it was recommended in the light of traffic levels to build only one lane per direction of the originally proposed motorway. Compared to the full motorway solution, for the initial phase, planning costs were 90%, land acquisition and

preparation of the alignment 100%, structures and tunnels 65%, road surfaces etc. 60%. The economic rate of return was improved by 25% through proposing phasing. In another case, the original proposal was to construct a toll motorway as a PPP project. Whereas initial studies had shown a sufficient traffic level to economically justify the construction of a motorway in the case of absence of tolls, EIB and interested private parties expected traffic levels to be significantly lower in a tolled case, which was supported by further studies. As there was a strong Government interest to build a motorway, a semi-motorway option as suggested by EIB was rejected, tolls and PPP intentions were finally dropped and the motorway constructed in conventional manner.

There are situations, where phasing would have been recommended or demanded a few years ago: It used to be common practice in many countries to reduce motorways to one lane per direction in longer tunnels with in a single bore. After the spate of tunnel fires in Alpine tunnels, discussion has restarted whether such cost-efficient solutions can still be recommended for heavy traffic loads.

One important effect, which is to be considered, is overloading of secondary networks in case of spatially phased or partial project implementation. There are cases in which EIB has suggested to enlarge the project scope in order to avert adverse effects which may have been overlooked by a promoter focussing on the individual project rather than its embedding into the existing network infrastructure.

## **8. Conclusion**

When comparing (road) infrastructure development plans and present budget constraints, especially of countries about to or aiming to join the European Union, the need for an efficient use of funds becomes eminent in the process of bringing transport networks to EU standards. Phasing can be considered in two dimensions, spatial and temporal. Spatial phasing is the selection and (temporal) prioritization of projects out of an investment programme and is common. Temporal phasing, the staggered provision of infrastructure specifications such that capacity levels harmonise supply with traffic demand rising over time, needs to be carefully considered. In a wider context, the application of the methodological framework of “real options theory” to transport projects might give interesting new insights for project phasing.

Motorways are certainly more appealing than ordinary roads, high-speed train systems more attractive than ordinary railways. But such solutions are not always the most efficient solution in the light of traffic levels and costs. The paper has sketched EIB’s evaluation approach for infrastructure investments and options for project phasing.

The possibility an active Bank role in project phasing depends on the status of a project or investment programme at the time when EIB is asked to become involved. Naturally, the earlier the contact is made, the more possibilities exist draw on the Bank’s expertise to optimise the final configuration of a project.



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Mr. Mateu Turró, associate director, and several colleagues within the Projects Directorate at the EIB have provided background information used in this paper and have contributed through sharing their experiences on the topic.

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