INTERNALIZATION OF THE COST OF ENVIRONMENTAL IMPACTS IN ROAD CONSTRUCTION PROJECTS

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The requirement of an Environmental Impact Assessment (EIA) in road construction projects in Greece was introduced only recently. The EIA, based on a common questionnaire for all kinds of public works, indicates measures that correspond to the nature of each project and facilitate the management of the impact of each specific project to the natural environment. Furthermore, the imposed measures bring about an additional cost of the work, differentiating its budget as well as the expenses of all involved parties. Nevertheless, Greek legislation does not include an explicit provision regarding financial evaluation of this additional cost, and this fact results in several problems. More specifically, without properly accounting for this additional cost in the initial budget of a road construction project, the funds allocated to the work are often proved to be unrealistic and the whole project runs the risk not to be accomplished due to insufficient financing. This paper presents a method for the financial evaluation of the measures suggested by the EIA and the consolidation of the cost of measures. Thus, the additional costs are internalized in the initial budget of the project and the whole process of road construction projects is organized more rationally from the early stages of project planning. Furthermore, in some cases tender offers give extremely high percentages of discount, without estimations of the additional costs that arise from the implementation of the measures imposed by EIA. The result is rendered intolerable, especially when the Supervising Authority imposes the implementation of approved environmental measures. This problem can be avoided through an in depth research in the available literature and through the introduction of a tool based on Cost-Benefit Analysis. The paper presents the application of these methods to a case study in Greece.
Key words: Environmental Impacts, Road Construction, Environmental Management

INTRODUCTION

The rapid growth worldwide led to the accumulation of ecological problems rendering essential the protection of the environment via legislative provisions. More than 100 countries have instituted some form of legislation concerning Environmental Impact Assessment (E.I.A.). Yet these regulations vary widely in their details and in the way they are practically implemented due to a number of political, economic and social factors. (Briffert 1999, Brito & Verocai 1999, Glasson & Salvador 2000, Glasson *et al.* 2005, Kakonge 1999, Mao & Hills 2002, Wang *et al.* 2003, Weiss 1989). In Greece the assessment of environmental impacts of road construction projects is obligatory. The environmental impacts should be determined, evaluated and included in the cost-benefit analysis of the project. The final decision on a road construction project should be taken after serious and balanced evaluation of the technical, economic and environmental parameters of the project.

In Greece public works were realised based on the criterion the most economic solution that was not environmentally suitable in every case. However with the establishment of the requirement of E.I.A. during recent years the environmental dimension has been taken seriously into account. The law is very concrete for the need and importance of the environment, but the application of the law unfortunately in many cases is considered a formal process. The measures suggested in the E.I.A. are not used with regard to the economic evaluation of a road construction project. As a result it may be impossible to determine fully and realistically whether the project should be constructed or not.

The cost of a road construction project includes the cost of design studies, the cost of expropriations and the cost of construction (Lampropoulos *et al.*, 2005). The evaluation of impacts from a potential failure of the project takes place at the stage of technical analysis. It offers the possibility of assessing consequences and repercussions that are not easily translated in money as illnesses, accidents, the loss of life, the pollution of atmosphere, ecological destructions etc. Specifically road construction projects during planning, construction and operation present characteristics of uncertainty and the relative questions need to be addressed based on methods from many scientific fields (Manouris, 2005).

The most important stage for the completion of a road construction project is the construction stage. The desirable situation in this phase is the minimisation of the risk of not accomplishing the project. It is not uncommon the involved parts to submit offers for road construction without including the total or part of the added cost that emanates from the economic evaluation of measures that are imposed by the E.I.A.

As a result the work is executed with an increased danger not to be completed because it is exceptionally difficult and time-consuming to find additional funds to cover the added expenses. Moreover when excessive curtailments in favour the economy of work are made, the project becomes vulnerable to external factors. In many cases contractors offer exceptionally high discount rates without examining the cost of measures dictated by the E.I.A. The result is unbearable specifically when the controlling authority imposes the application of approved environmental requirements.

The objective of the paper is to present the importance of environmental impact studies in road construction projects. More specifically an attempt is made to calculate how the results of an E.I.A. can influence the cost of construction and the project

schedule. A suitable tool is developed so that bids with exceptionally high rates of discount are avoided and the risk of not completing the project because of additional costs is minimized. The tool is applied to a case study so that its efficiency is examined and it is decided whether it can be used effectively for decision-making.

TECHNIQUES OF ENVIRONMENTAL IMPACT VALUATION

The determination of a monetary value for the environmental damage plays important role in environmental economics. Economic assessment techniques are classified in two basic categories: in techniques that make use of the demand curve and in those that do not make use of the demand curve and thus cannot make genuine assessment for a cost – benefit analysis (CBA). Methods in the first category include the "expressed preference methods" and the "revealed preference methods" in which the monetary value of environmental goods is revealed not by the actual or likely users, but indirectly. Expressed preference methods include the contingent valuation method, which allows individuals to place direct prices in the environmental goods and services. Revealed preference methods include the travel cost method and the hedonic pricing method. In the category of methods that do not make use of the demand curve belong the dose response method, the replacement cost method and the mitigation behavior method (Zagorianakos, 2002). All these economic valuation tools come from different directions but share a common goal: to internalize operations of the natural environment in the economic reality by estimating their correct values.

The valuation requires extensive economic data acquisition, which is costly and time-consuming. Moreover certain economists of the environment dispute the objectivity of the assessment. The political institution, which is finally responsible to decide if the project should advance, can assign the assessment to a team of researchers consenting to its own views. Many years ago some economists warned that the cost-benefit analysis can become a precarious and corrupted science. The governmental organizations may inflate the profits or underestimate the environmental costs so that they justify projects and thus perpetuate their vested interests. An economic investigation may be proven to be just a set of complicated studies aiming at acquiring wider acceptance of decisions which have already been taken based on certain other criteria (Kula and Protopapas, 2005).

METHODOLOGY

The requirement of E.I.A. for new road construction projects was introduced as a safeguard for evaluating the environmental repercussions of a specific project. The E.I.A. study proposes concrete methods to forecast, restrict or mitigate these impacts. The difficulty of this process lies actually on the fact that most impacts are intangible and difficult to value. The present research proposes a method that constitutes an economic assessment of imposed impacts. The proposed method attempts to determine pecuniary values for environmental repercussions that cannot be valued easily in monetary terms and is based on conventional cost-benefit analysis. As it is shown in the present work provided that the method of cost – benefit analysis is used in combination with other methods and simultaneously possible generalizations and simplifications are avoided, the method can provide a reliable source of recording the impacts.

Table 1 which constitutes the basic tool proposed in the present research is based mainly on the questionnaire currently used in E.I.A. practice. In the second column the environmental impacts of the project are described as well as their classification according to: S Strong, M Mediocre, W Weak, N Neutral, P Positive. Table 1 examines the environmental impacts based on the approved E.I.A. Further the classification of impacts is conducted assuming that all proposed measures in the E.I.A. will be applied. The fourth column includes the measures that are judged essential according to the E.I.A. as have been approved by the responsible Authority and the fifth column contains the real economic valuation of the above-mentioned measures.

Table 1: Example of tool for managing environmental impacts

Structural work on road construction*			Most common environmental impact		Valuation technique	Measures of mitigating environmental impacts	Economic valuation
			S M W N P				
D. Natural environment							
2	Fauna	1	Change in the variety of species or in the number of any animal species (birds, animals including reptiles, fish and marine benthic organisms or insects)	STRONG Danger of accidents for animals crossing the road. Nuisance on fauna because of high intensity of noise caused by road traffic and worksites and because of the precarious change of landscape.	Contingent valuation method (CVM) Cost-benefit Analysis	Planning of passages in the form of slab covered culverts of width at least 3 m for the unhindered movement of fauna. The culverts must be easily accessible from the ground, must be leveled to it or must have ramps of suitable slope and their exit must be visible from the entrance. When the passage of fauna is not ensured by the technical work, a minimum number of passages is provided at least 1 per 300 m of road.	In addition to the culverts that are planned because of the road specifications, five more are needed as passages of animals. Work for their construction is budgeted in the section of technical designs. Cost: €34.000

*** Small up to intermediate impacts on the environment. The undertakings are usually carried out for the improvement - maintainance of existing segments of road networks and new road segments.**

This particular table-tool of research was used after thorough study and analysis of all data relative to studies of environmental impacts of road construction. The aim of using this tool of research is 1) to create a theoretical framework for the economic valuation of environmental impacts as presented in the case study, and 2) to provide a valuation of the environmental provisions of E.I.A. so that it can be judged if further economic study is required on the project budget regarding the cost of application of measures and in this way the elimination the danger of not completing the project because of insufficient financing.

CASE STUDY

The case study concerns the application of the proposed methodology to the construction of a provincial road. The goal of this process is to conclude whether and to what extent the economic valuation of environmental impacts can be proved useful in the process of decision-making. Also to demonstrate the usefulness of including to the project budget a separate section with the cost that results from the implementation of environmental terms that the E.I.A. dictates.

The town of Loutraki is the top spa resort in Greece. Currently there is only one main road that runs through the town, carrying all the traffic. Enormous problems for the quality of life of residents and tourists are present. The proposed road is expected to achieve the safe and rapid transport of visitors to the town of Loutraki and divert the main circulatory pressure that is directed to the area of Gerania mountains. The heavy vehicles will by-pass the city, alleviating the environmental pressure.

The project "Improvement of provincial road Loutraki – Perahora" is financed by the Region of Peloponnese and is constructed by the Technical Services Department of the Prefecture of Korinthia. The road is category of type E/8,5 in all 4,03 km length with speed of study 50 km/h, speed of traffic 44 km/h, maximum slope 6-7%, and minimum distance of visibility 60 m. The cross-section width of the is capable to include one lane per direction. Four intersections will be constructed and six culverts to carry the water of streams and provide flood protection.

The total cost of the project is €5.500.000 of which 5,5% is paid for design studies, 75,5% for construction, 18,2% for expropriations and 0,9% for general administrative expenses. The cost of expropriations will be finalized only after a court decision specifies the unit price for land. The minimum bidder for the construction works offered an average discount of 22% on the total budget of €4.150.000 as shown in Table 2.

The information for the economic valuation of environmental measures was taken from all available sources, most important of which are:

Design studies that concern the project, such as

- Final study of the project
- Final geological study
- Final study of underground pilesheet

Construction contract

All the contractual documents constituted important source of economic elements for the project

Project schedule

Published analytical prices for road construction projects

Market prices for materials and labor that have not published prices

Progress logs for the project

Personal interviews with the all involved parts (contractor, consultants, supervising engineers).

The conclusions that are drawn concern the sufficiency of existing budget against the budget that results adding the cost of environmental terms. It should be pointed out that it is exceptionally difficult to gather the particular economic data with regard to the cost of measures, as no assessment method has included the cost of measures that are imposed by the E.I.A. and consequently most of the required data have been included in the budget without reference or have been implied or even have been ignored.

Table 2: Project budget and contract structure

	Work Category	* Budget (including VAT 19%, general expenses and profit 18%, unanticipated expenses 15%, revisions €)	Discount offered by contractor (%)	Contract (€)	Percent of Total Budget
A	Earth works	818.260	20	654.608	20,2
B	Technical works	1.574.534	22	.228.136	37,9
C	Road paving	913.910	22	712.850	2,2
D	Asphalt paving	755.083	24	573.863	17,7
E	Signing and Insurance	88.213	22	68.806	2,1
Total:		4.150.000	22	3.238.263	

Table 3 presents the total additional cost because of the imposed measures for the project. The total increase is analyzed according to each category of impacts (soil, atmosphere etc.) and has repercussions both on the owner and the contractor. It concerns the expenses that they are included in the budget and additional expenses for which additional financing must be ensured. The total economic cost with regard to the environment amounts to at least €907.700. More specifically:

1) It is calculated that apart from the total cost of €300.000 that has been allocated already to the studies for the E.I.A., the required terms impose an additional cost of €83.000 for supporting studies, e.g. delineation of streams, special landscaping studies, traffic study etc.

2) It is obvious that the added cost at 28% of the cost of initial studies leads the owner of the project to the pursuit of additional funding. This fact can consequently cause delays in the project during construction and justified claims by the contractor for compensation because of the revisions in the updated market prices. The contract cost for the construction of the project in Table 2 compared to the additional that results as it is presented in Table 3 demonstrates that there exists a need for more funds. The increase of required funds is caused mainly because of the term for the protection of exposed excavations in the region of the project.

3) A secondary increase is caused because of the rejection by the local society of the proposed soil pits that was expressed very late after the completion of the E.I.A. and the beginning of construction work. The measures also impose a small added cost of maintenance that had not been planned. Overall the added cost for financing the project that should be ensured by the owner is at least €532.000, which is a 14% increase to the total construction cost of €3.906.526 that includes the contract, design studies, expropriations, general administrative expenses etc. The amount for unanticipated expenses in the contract

covers up to €351.991 (Table 2). The balance of 180.009 € should be covered by new credits.

4) Comparing the sum in Table 2 that is determined by the contract and includes the general expenses and the contractor's profit with the elements in Table 3, it can be observed that the contract does not cover (it is precisely €17.709 less than) the added cost paid by the contractor because the application of the provisions of E.I.A. At this stage the contractor suffers a loss, his expenses are not covered and his profit, which has been calculated with average discount of 22% at €357.991, is vanished. Bidding with a lower discount rate, that would have included the cost for the environmental terms, could have achieved a profit at the construction phase.

Table 3: Total cost of environmental measures for the case study

Cost of measures that concern:		Total Cost (€)	Total Cost		Additional Cost	
			Included	Added	Paid by the Owner	Paid by the Contractor
A	Soil	988.100	546.100	442.000	420.000	22.000
B	Air	279.500	5.000	274.500		274.500
C	Water	464.000	374.000	90.000	75.000	15.000
D	Natural environment	305.200	216.000	89.200	32.000	57.200
E	Noise	6.500	varies	6.500	5.000	1.500
F	Socio-economic environment	963.650	958.150	5.500	0	5.500
	Total	3.006.950	2.099.250	907.700	532.000	375.700

CONCLUSIONS – DISCUSSION

In this paper an effort is made to investigate the practice of E.I.A. in Greece and to calculate the total added cost of a road construction project that results because of the application of measures that are dictated by the E.I.A. It was found that currently no particular theory is used either for the valuation of the cost of real impacts or of the cost of the application of measures. Consequently a tool was developed in the form of a table for the valuation of impacts. The table includes the real cost of mitigation measures. The application of methodology in the case study "Improvement of provincial road Loutraki - Perahora" yields the following conclusions:

1) The application of valuation techniques of impacts is exceptionally important because the knowledge of economic cost of impacts can lead to the optimal choice of preventive or corrective measures and the proper management of required financing. In addition fewer problems are created in the projects because the necessary capital is determined more precisely.

2) Consequently the unpleasant and dangerous situation during construction of a project where the additional capital cannot be covered by the unanticipated expenses of the contract is avoided.

3) The bids become more objective because the added expenses can be included in the calculation of the offered discount rate.

4) Precisely because the valuation techniques determine the enormous consequences of not conforming to the measures, they can shape a persuasive argument for the detailed application of environmental requirements.

If the additional expenses that result from the application of measures are not calculated, there is a serious deficiency in the process of offer submission from the state viewpoint. It is proposed that an additional document should be included in the bid, which will include an economic analysis of environmental terms in order to determine precisely the additional cost in the expenses of the contractor. The bid evaluation committee should check in detail whether the bidder has included the cost of the environmental terms before it proposes his acceptance as contractor.

Moreover the conduct of techno-economic study should be required by the state after the completion of E.I.A. In the proposed study there will be an economic valuation of the environmental impacts, as well as of the environmental measures of their prevention or mitigation. In this manner the required capital is calculated precisely and it is also possible to schedule the required financing so that the risks for its completion are minimized.

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