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METHODOLOGY FOR PREPARATION OF COMMUNICATIVE COST BENEFIT ANALYSIS IN ENVIRONMENTAL IMPACT ASSESSMENT

METODOLOGIJA IZRADE KOMUNIKATIVNE ANALIZE TROŠKOVA I KORISTI U PROCJENI UTJECAJA NA OKOLIŠ

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Abstract
Standard cost benefit analysis as applied in economic practice and studied in the relevant literature means a quantitative assessment of feasibility and justification of an investment project. The decision on execution of an investment project is normally based on such an analysis, but it is left to the investor's discretion either to prepare it or not. However, every activity in the space unavoidably impacts the environment and this is true for investment projects as well. Generally, an analysis should determine whether or not the project warrants a balanced approach to environmental protection in harmony with sustainable development, taking also into account the investor's business goals. Sustainable development pursues and tolerates investments aiming at making profit, however part of such a profit must contribute to environmental protection. Such an approach is essential in order to ensure sustainable development; this is a closed circle which does not have any alternative. Accordingly, it is the responsibility of the investor, as determined by relevant legislation, to prove that the planned project will not adversely impact the environment. Faculty of Civil Engineering in Osijek has developed a methodology for preparation of cost benefit analysis in environmental impact assessment, as an outcome of a scientific project financed by the Ministry of Science, Education and Sport. The methodology has already been applied in a number of environmental impact assessments. This paper presents the methodology and its application as well as the role of communication in the process of preparation and approval of environmental impact studies.

Sažetak
U svakodnevnoj ekonomskoj praksi i literaturi standardna analiza troškova i koristi podrazumijeva kvantitativno vrednovanje opravdanosti i isplativosti određenog investicijskog projekta. Odluka o izvođenju investicijskog projekta redovito se donosi na osnovi takve analize, ali je njena izrada diskrecijsko pravo ulagača. Međutim, svaki zahvat u prostoru, pa tako i investicijski projekt, nužno utječe na okoliš u kojem se ostvaruje. Općenito rečeno, provedena analiza mora ukazati na to osigurava li određeni projekt uravnotežen pristup zaštiti okoliša u skladu s održivim razvitkom, a s obzirom na poslovne interese. Održivi razvitak zahtijeva i dopušta proizvodna ulaganja koja ostvaruju profit, ali iz profita se mora izdvajati i doprinos zaštiti okoliša, što je opet uvjet održivog razvitka. Takav pristup je nužan. To je zatvoreni krug koji nema alternativu te je zbog toga zakonom propisana obveza ulagača analizom troškova i koristi dokazati da planirani projekt neće štetiti okolišu. Na Građevinskom fakultetu u Osijeku, kao rezultat znanstvenog projekta financiranog od Ministarstva znanosti, obrazovanja i sporta, razvijena je metodologija izrade analize troškova i koristi u procjenama utjecaja na okoliš. Metodologija je uspješno primijenjena u brojnim procjenama utjecaja na okoliš. U radu je prikazana metodologija i njena primjena kao i uloga komunikacije u procesu pripreme i prihvaćanja studije utjecaja na okoliš.

Introduction

Cost-benefit analysis is a method of evaluating the eligibility of activities in the environment and is often used to support decision-making in environmental protection. Definition of cost benefit analysis can be found in the literature /**1**/, /**2**/. Classic cost-benefit analysis in everyday business practice and literature involves quantitative evaluation of feasibility and cost-effectiveness of a particular investment. Decisions on the implementation of investment projects are regularly made on the basis of such analysis, but its production is at the discretion of investors. However, any intervention in the environment, including investment projects, necessarily affects the environment in which it is to be achieved. The Environmental Protection Act (Official Gazette 110/07) and the Regulation on the Environmental Impact Assessment (Official Gazette 64/08 and 67/09) prescribe the implementation of the process of environmental impact assessment in Croatia. Environmental costs are external costs that an activity causes to the environment and this is the definition adopted in the provisions of the Regulation that defines the benefits and costs as included in the cost-benefit analysis. Also, internal costs of the project should be included in cost-benefit analysis /**3**/. Assessment of the environmental impact depicts the possible direct and indirect impacts of the project on the soil, water, sea, air, forests, climate, human health, wildlife, landscape, material assets and cultural heritage, taking into account their interrelationships. Assessment of environmental impact must ensure the realization of the precautionary principle in the planning phase of the project in order to minimize the project impact to the lowest possible level and to achieve the best possible preservation of environmental quality. This can be achieved by adjusting and adapting the intended project to the absorbing capacity of the environment in a particular area. Assessment of the environmental impact is carried out within the framework of the preparation of the planned project, before issuing building permit for the project or another approval if the issuance of building permit is not required. The Act also stipulates the obligation of preparing an analysis of costs and benefits, resulting from the impact of a project on the environment. Such analysis is an integral part of the environmental impact study. Generally speaking, the analysis must indicate whether a particular project ensures a balanced approach to environmental protection in accordance with sustainable development, taking also in the account business interests. In other words, sustainable development requires and permits productive investments that make profit, which in turn is needed to contribute money for environmental protection as a condition for sustainable development. It is a vicious circle that has no alternative. Regulation, however, does not prescribe any methodology for the cost-benefit analysis. Moreover, in practice, the environmental impact study, including cost-benefit analysis as an integral part, is usually made when the investment project has already been defined and a decision on his implementation has been made on the basis of the classical feasibility study of (without taking into account the costs of environmental protection). Such an approach is wrong, because the identification and evaluation of all factors related to the investment project must be the basis for a decision on acceptance or rejection of the project with regard to its impact on the environment. It can be assumed that many of the projects, realized after the entry into force of the said Act and Regulation in Croatia, would not have received approval and would not be brought to realization had the cost-benefit analysis been made in a fair manner and had the results of this analysis been the deciding factor for getting approval. It was therefore necessary to improve, formalize and prescribe the methodology of cost-benefit analysis, and harmonize it with the practice of advanced countries. To these ends, the Civil Engineering Faculty in Osijek, as a result of the research project financed by the Ministry of Science, Education and Sport, developed a methodology of cost-benefit analysis to be applied in environmental impact assessments. The methodology has been successfully applied in a number of assessments.

Quantifiable and non-quantifiable benefits and costs

Two basic methods of assessing environmental costs through cost-benefit analysis have been developed in accordance with the Regulation on the Assessment of the Environmental Impact /**4**/. One method is the indirect determination of measurable costs and benefits of the environment, expressed in monetary units, which is a condition of

conducting the internalization of external costs. The other one is the so-called expression of non-measurable costs and benefits to the environment through a variety of scales for comparing values. In the application of both methods some questions arise that need to be addressed by a proper methodological approach.

Costs and benefits in the cost-benefit analysis should have, according to the basic idea which has an economic background, a market value and should be monetarily expressed. The basic formula for the relationship between benefits and costs (net benefit), expressed monetarily, is as follows:

$$(B-C)=\left\{ \sum_{t=1}^{T} \frac{B_t}{(1+i)^t} - \sum_{t=1}^{T} \frac{C_t}{(1+i)^t} \right\}$$

where:
(B - C) net benefit
i the discount rate of benefits / costs
Bt, Ct benefits / costs expressed in monetary units after the time *t*
T total project duration.

Some environmental costs can be determined through their use or market value (e.g. environmental protection measures, the cost of repair, etc.). However, one of the questions is how to express the cost that cannot be directly monetarily expressed. Some of the methods which in this case can be applied are: the willingness to pay for environmental protection, the willingness to accept environmental pollution, the cost of travel, hedonic property value, replacement cost, benefit transfer, etc. A comprehensive review of these methods can be found in the literature /**5**/. When applying these methods, the priority should be given to those which are cost-based /**6**/. There is also a methodological approach for evaluating of the costs that cannot be monetarily expressed. Reasons why monetarily expression of these costs is not implemented are of theoretical nature and are linked to the assumption that some parts of the environment (natural and cultural capital) cannot be expressed in monetary terms, in other words they cannot be measured by economic methods /**7**/. The techniques used to view and compare these types of costs are those which apply ordinal, interval or rational scales for assessment /**8**/, and in some other cases which use the weight coefficients. Methods of collective decision-making are also used in some cases (expert group evaluation and Delphi technique) /**9**/. A particular issue is how to express the cost of risk of possible accidents in the environment. So far, only one environmental impact assessment was carried out in Croatia, in which the cost of ecological disaster was evaluated. According to /**10**/, assessment of the cost caused by environmental accidents can be generally calculated as follows:

$$EV(X) = p(X) \cdot C(X)$$

where:
EV (X) the expected value of the cost of ecological disaster
p (X) the probability of an event X
C (X) the total size of the cost (environmental damage) in the case of accident

Risk assessment, required for cost benefit analysis can be done by using different models /**11**/.

The methodology of cost-benefit analysis

The methodology developed at the Faculty of Civil Engineering in Osijek /**12**/, divides the cost-benefit analysis into two parts: 1) evaluation of monetarily measurable impact, and 2) evaluation of monetarily immeasurable impact on the environment. Impacts that cannot be evaluated in monetary terms are evaluated qualitatively, based on the expert group assessment. The analysis evaluates the costs and benefits during the construction and operational phases of the project, using the data from the environmental impact study.

Monetary immeasurable impacts are assessed by the expert group and are evaluated against the following criteria:

~ A - socio-political impact of the project on the local community
~ B - economic impact of the project on the immediate surrounding
~ C - economic impact of the project on the wider surrounding
~ D - ecological impacts.

An example of such an assessment (for a planned cement mill) is given in Table 1.

Table 1. Example of an expert group assessment

Criterion		Experts			Medium weight
		1	2	3	
A	*Socio-political impact of the project the local community*	1.0	1,0	1,0	***1,0***
B	*Economic impact of the project on the immediate surrounding*	0.7	0,8	1,0	***0,8***
C	*Economic impact of the project on the wider surrounding*	0.5	0,5	0,5	***0,5***
D	*Ecological impact*	1.0	1,0	1,0	***1,0***

Source: Project no. 149-1491678-0980 (2007-2013): *Vrednovanje odnosa investicijskih projekata i okoliša*, project coordinator Ksenija Čulo – CBA cement kiln Cemex d.d.

The criteria obtained by expert judgment apply to particular impacts that cannot be quantified in monetary units, i.e. to the monetary non-quantifiable impacts, as shown in the example (for the planned cement factory) in Table 2.

Table 2. Example of evaluation monetarily non-quantifiable impact according to individual criteria

Impact	Criterion				*Total weighted score*
	A	B	C	D	
Impact on air quality	0	-12,0	0	-24,0	***-6,5***
Impact on soil, surface watzer und underground water	0	-12,0	0	-15,0	***-6,8***
Impact on plants and animals	0	-1,6	0	-6,0	***-1,9***
Impact on landscape	0	0	0	-30,0	***-7,5***
Noise impact	-21,0	-4,8	0	-21,0	***-11,7***
Impact on cultural and historical heritage	0	0	0	0	***0***
Impact on the existing roads	-21,0	-6,4	0	-12,0	***-10,6***
Risk of accidents	-18,0	-6,4	-3,0	-15,0	***-10,6***
The impact of harmful gases and dust substances on humans, plants and animals during usage	0	-4,0	0	-21,0	***-6,3***
Change in property value	-15,0	-4,0	0	0	***-4,8***
Problems linked with the administrative, economic and social infrastructure in the acceptance of increased traffic of people and goods	-15,0	-4,0	0	0	***-4,8***
Total damages:					**-71,5**
Prosperity of local and wider community	+15,0	+4,0	+1,5	0	***+5,1***
The growing need to urbanize surrounding areas	+12,0	+1,6	0	+12,0	***+6,4***
Increased volume of residential construction	+15,0	+6,4	0	0	***+5,4***
Supporting the economic development of the areas in immediate and wider community	+21,0	+4,0	+4,5	0	***+7,4***
Arranging existing infrastructure	+9,0	+12,0	+12,0	0	***+8,3***
Satisfaction of newly employed workers	+30,0	+6,4	0	0	***+9,1***
Social standard of immediate and wider community	+24,0	+8,0	0	0	***+8,0***
Existence of families of newly employed workers	+24,0	+6,4	0	0	***+7,6***
Job creation in supporting economic fields	+30,0	+6,4	0	0	***+9,1***
Fitting into the development strategy of Croatia	0	0	+4,5	0	***+1,1***

Increasing social capital through the inflows of younger skilled workforce	+15,00	+4,0	0	0	***+4,8***
Total benefits:					**+72,3**

Source: Project no. 149-1491678-0980 (2007-2013): *Vrednovanje odnosa investicijskih projekata i okoliša*, project coordinator Ksenija Čulo – CBA cement kiln Cemex d.d.

The impact on the environment is also assessed for each monetarily measurable impact, and for all the years during the specified period. The time horizon is usually equal to the time horizon applied in the financial analysis of the feasibility study made by the investor, if any. If there is no financial analysis, the time horizon is assessed. Because of discounting, i.e. reducing all amounts to the present value, taking the time horizon beyond 20 or 25 years would not significantly affect the result of the analysis.

An example of the calculation of monetarily measurable impacts on the environment (for the planned cement factory) is shown in Table 3. The resulting net difference between benefits and costs are discounted on the net present value using a discount rate of 5%.

Table 3. Example of calculation of monetarily measurable impact on the environment (in 000)

Year / Impact	2008	2009	2010	2011	2012-2018.	2019	2020	2021	2022	2023
Cost:					…					
Impact on traffic					…	1250	1250	125	125	1250
Relation with population	1000				…					
Benefit:					…					
Tax on real estate	4900				…					
Tax on income of construction workersi	300	300	300	300	…					
Concession on extraction of minerals	300	300	300	300	…	300	300	300	300	300
Tax on consumption of construction workers	600	600	600	600	…					
Water management fees	600	600	600	600	…	1105	1105	1105	1105	1105
Utility fees	6200	6200	6200	6200	…	1243	1243	1243	1243	1243
One time municipality income	5700				…					
Tax on income of factory employees					…	600	600	600	600	600
Tax on profit					…					
Tax on consumption of factory employees					…	100	100	100	100	100
Donations					…	700	700	700	700	
Contribution to Fund for NO_2					…	2520	2520	2520	2520	
Contribution to Fund for SO_2					…	2688	2688	2688	2688	
Contribution to Fund for CO_2 i CO_3					…	53200	53200	53200	53200	
Contribution to Fund for solid waste					…	120	120	120	120	
Total benefit:	**1860**	**8000**	**8000**	**8000**	…	**74768**	**74768**	**74768**	**74768**	

Total cost:	**1000**				…	**1475**	**1475**	**1475**	**1475**	
NET BENEFIT/COST:	**1760**	**8000**	**8000**	**800**	…	**73518**	**73518**	**73518**	**73518**	**94858**

Source: Project no. 149-1491678-0980 (2007-2013): *Vrednovanje odnosa investicijskih projekata i okoliša*, project coordinator Ksenija Čulo – CBA cement kiln Cemex d.d.

The described methodology has been applied so far in the environmental impact studies of nineteen investment projects, namely:
- Five shopping malls
- Five state roads
- Three cement mills
- One quarry
- Five water reservoirs.

Communication

Communication is important and sometimes critical for successful preparation and approval of environmental impact studies. Many of the non-measurable elements of cost and benefit related to project environmental impacts cannot be evaluated or assessed without proper communications. Such elements can be evaluated through surveys, interviews or inquiries related to population conducted in the local community or wider surrounding. These activities should be well prepared and their purposes communicated up front to local population so that the activities can produce reliable data for the study. Once the draft environmental impact study has been prepared, it should be exposed to the public for comments through the process of public hearing. The study should be made available in a summary form as to enable the wider public to understand the main features of the study. Critical step in the process of public hearing is a good communication between the study authors and the public, whereby the authors should find the proper way to explain and communicate the results of the study to the affected population. Many environmental impact studies have failed to get approval, because not enough attention has been paid to proper communication with stakeholders.

Conclusion

Good cost-benefit analysis, as part of the environmental impact study, should indicate the following to the investors:
- How to plan investment, and
- How to realize the project while at the same time satisfying the interests of society (the feasibility study should indicate fulfillment of the interests of investors). However, the authorized creators of environmental impact assessment in Croatia face some difficulties, such as:
- Legislation on environmental impact assessment in Croatia has not been yet fully aligned with those of the European Union.
- The methods of environmental impact assessment applied in the European Union have not been thoroughly studied in Croatia.

What to do?
1. Distinguish quantifiable from non-quantifiable impacts.
2. Particular attention should be devoted to evaluating immeasurable impact using several methods.
3. Standardize the methodology for cost-benefit analysis in the Republic of Croatia.
4. Involve the public through proper communication in all stages of the preparation of the environmental impact study.
5. Include professional, objective and independent people - economists and experts on the environment.
6. Take away the financing of studies from investors in order to ensure objectivity in their preparation.
7. Monitor environmental impacts of current operations in order to create a database for risk analysis of investment projects.

Notes

/1/ Gilpin, A. (1996): *Dictionary of Environment and Sustainable Development*, J. Wiley &Sons, p. 50
/2/ Rumenjak, D. (2002): *Metoda troškova i koristi u procjeni utjecaja na okoliš*, Simpozij o gospodarenju otpadom, Zbornik radova, Zagreb, pp. 761-774
/3/ Potočnik, V. (2003): *Analiza troškova i koristi energane na otpad Zagreb*, Gospodarstvo i okoliš, Zagreb, p.122

/4/ Rumenjak, D. (2002): *Metodologija procjene rizika u procjeni utjecaja na okoliš*, Savjetovanje Sigurnost u okolišu, Zbornik radova, Solaris, p. 25

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/12/ Project no. 149-1491678-0980 (2007-2013): *Vrednovanje odnosa investicijskih projekata i okoliša*, project coordinator Ksenija Čulo – CBA cement kiln Cemex d.d.