PARTICULARITIES OF COST-BENEFIT ANALYSIS IN CONSTRUCTION PROJECTS

Cezar Simion-Melinte, Assist. Prof., PhD, University of Economic Studies, Bucharest

Abstract: Cost - benefit analysis is a method of assessing a project that quantifies in monetary terms the value of all the effects of the project on the investor and / or society. The main purpose of cost - benefit analysis is to base funding decisions and implementation of construction projects. Cost-benefit analysis can be done ex - ante, ex post, during the project or during project operation. The analysis can aim a comparison between ex-ante and ex-post. This comparison is very useful to determine the effectiveness of a cost benefit analysis as a tool for evaluation and decision making. The most commonly used is the ex-ante which is usually done in the feasibility phase of construction projects.

Keywords: cost, benefit, analysis, construction, projects.

1. Introduction

The main objective of cost-benefit analysis is useful in making decisions for construction projects or modernization / expansion / rehabilitation of existing ones. You must determine whether the analysis is carried out adopting a local, regional, national, EU or global level. Appropriate level of analysis to be determined in relation to the size and scope of the project and in relation to group / area in which the project has a relevant impact.

The purpose of cost - benefit analysis is to identify and quantify (i.e to give a monetary value to) all possible impacts of the action or project in question, in order to determine appropriate costs and benefits. All impacts should be assessed: financial, economic, social, environmental, etc.

2. Steps to achieve cost-benefit analysis

Cost - benefit analysis for construction projects is divided into seven stages:

- Definition of objectives ;
- Identify project ;
- Feasibility and options analysis ;
- Financial analysis ;
- Economic analysis ;
- Multi-criteria analysis;
- Sensitivity and risk analysis.

The first step can be considered preliminary. The most important steps are the financial and economic analysis. The purpose of financial analysis is to use the project's cash flow projections to calculate the appropriate return rates: IRR and NPV financial .

Projections regarding future trends of the project should be made for an adequate period of its useful economic life and long enough to consider the impact on the medium / long term. The choice of time horizon may have a crucial effect on the results of the evaluation process. More specifically, the choice of the time horizon affects the calculation of key indicators of cost-benefit analysis. The economic analysis evaluates the project's contribution to the economic wellbeing of the region or country. It is made on behalf of the entire company (region or country) instead of just the facility owner that the financial analysis.

3. Typology of analysis cost – benefit

There are two main types of cost-benefit analysis. Cost-benefit analysis ex-ante, which is a cost standard -beneficiu performed while a project is still anthem study before implementing or starting to. Cost-benefit analysis is done you are ready to decide whether or not scarce resources will be allocated for a specific construction project. Ex-ante analysis is performed in the feasibility phase of the project. Usually in Romania, it is part of the feasibility study. The contribution of cost-benefit decisions is direct, immediate and specific.

Cost - benefit analysis is carried out ex-post at the end of the project, when all costs are allocated, meaning that resources have been used in the project. The value of ex-post analysis is more comprehensive, but less direct because it provides information not only about the project but about the final efficiency of resource allocation for the project. Ex-post analysis can be an organizational learning tool for policy makers on the opportunity or funding of certain projects.

Other cost - benefit analysis is conducted over the life of a project, ie in medias res. Certain elements of this analysis are similar to those of ex-ante analysis while others are similar to the ex-post analysis.

A special type of cost-benefit analysis are comparing an ex -ante with one ex post or in medias res analysis for the same project. A similar type of cost-benefit comparison of greatest utility for policy makers because it demonstrates the effectiveness of cost-benefit analysis in terms of decision making.

Table no.1

The value of cost - benefit	**Class of analysis**			
	Ex - ante	**In medias res**	**Ex-post**	**Comparisons ex ante/ ex post sau ex ante/ in medias res**
The decision to allocate resources to a project	If the analysis is accurate, it helps to select the best project or lead to the decision to continue or to abandon the	If already allocated resources are low, the available resources could be diverted. If	Too late, the project is completed.	As in medias res analysis or ex post.

	project.	not, should continue.		
Finding the current value of a particular project	Poor estimation - uncertainty of future benefits and costs.	Best estimate - reduce uncertainty.	Best estimate - reduce uncertainty	As in medias res analysis or ex post.
Contributing to find out the current value of similar	Unlikely to have a significant contribution	Good. The more is done later, the contribution they grow. Adjusting for different projects .	Very useful, although errors may occur and require adjustments for different projects.	As in medias res analysis or ex post.
Research omissions, errors of estimating, measuring and evaluating the cost-benefit analysis	No	No	No	Provides information about errors and the accuracy of cost - benefit analysis for similar projects.

4.Case Study - cost-benefit analysis for the construction of a nursery

The building will have in plan dimensions of 19.80 mx 10.22 m and height of the ground floor for a group: 18 children. Length of investment is 12 months. The estimated cost of the investment was based on technical solutions for the project. The total investment for the project "Construction of a nursery group" is 360,240 thousand lei including VAT Values presented in euro has used an exchange rate of 4.2139 lei / euro at the rate BNR. Total cost proposed investment objective is presented as general estimate. According to some specialists ”not in all the analyzed methodologies calculation has as purpose the general quotation or the quotation on object” (C.Simion, M.Rus and C.Enulescu, 2008).

For cost-benefit analysis were considered two options:

- zero option (no investment) is a variant of the status quo which involves keeping the current situation without making any investment. This option, however, would not provide the minimum conditions for raising children whose parents want to re-engage.
- maximum variant (variant with maximum investment) investment project involving children's nursery with a group. This would increase the number of parents who want to re-engage.

In the financial analysis were quantified income and expenses arising from infrastructure created significant impact on local councils as beneficiaries of the investment.

The discount rate used to determine indicators was 5%, a rate considered normal for this type of project in the current socio-economic context.

Financial analysis resulted in two tables summarizing the cash flows for the chosen option, as follows:

1.Table financial sustainability

2 Table of calculating the internal rate of return on equity investments

The values of the efficiency indices obtained are shown in the following table:

Table no.2

Results efficiency indicators for financial analysis of the project

Indicator	Value
Internal Rate of Return (IRR)	0,54%
Net Present Value (NPV) (lei)	150.422
Benefice- cost ratio ($R_{B/C}$)	1,088

Since the project is not generating income NPV is positive although this is not significant because the project is important in terms of economic and social, so from the point of view of economic analysis.

Table no.3

Verification of project sustainability

Specification	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
INPUTS										
Financial Resources	360.240	0	0	0	0	0	0	0	0	0
Income from operations		115.000	115.000	120.750	126.788	133.127	139.783	146.772	154.111	161.817
Total inputs	**360.240**	**115.000**	**115.000**	**120.750**	**126.788**	**133.127**	**139.783**	**146.772**	**154.111**	**161.817**
OUTPUTS										
Operation and maintenance costs	0	79.988	113.470	112.564	114.495	115.640	117.123	118.628	120.155	121.703
Investment costs	360.240	0	0	0	0	0	0	0	0	0
Total outputs	**360.240**	**79.988**	**113.470**	**112.564**	**114.495**	**115.640**	**117.123**	**118.628**	**120.155**	**121.703**
Cash flow	0	35.012	1.530	8.186	12.293	17.487	22.660	28.144	33.956	40.113
Net Cash flow	**0**	**29.410**	**1.530**	**8.186**	**12.293**	**17.487**	**22.660**	**28.144**	**33.956**	**40.113**

Cumulative Net Cash Flow	**0**	**29.410**	**30.940**	**39.126**	**51.419**	**68.906**	**91.567**	**119.711**	**153.667**	**193.780**

Specification	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Year 16**	**Year 17**	**Year 18**	**Year 19**	**Year 20**
INPUTS										
Financial Resources	0	0	0	0	0	0	0			
Income from operations	169.907	178.403	187.323	196.689	206.523	216.850	227.692	227.692	227.692	227.692
Total inputs	**169.907**	**178.403**	**187.323**	**196.689**	**206.523**	**216.850**	**227.692**	**227.692**	**227.692**	**227.692**
OUTPUTS										
Operation and maintenance costs	123.275	124.507	125.752	128.484	131.316	134.254	119.148	128.824	139.355	142.724
Investment costs	3.000	0	0	0	0	0	0	0	0	0
Total outputs	**126.275**	**124.507**	**125.752**	**128.484**	**131.316**	**134.254**	**119.148**	**128.824**	**139.355**	**142.724**
Cash flow	43.633	53.895	61.571	68.205	75.207	82.595	108.544	98.868	88.337	84.969
Net Cash flow	**43.633**	**53.895**	**61.571**	**68.205**	**75.207**	**82.595**	**108.544**	**98.868**	**88.337**	**84.969**
Cumulative Net Cash Flow	**237.413**	**291.308**	**352.879**	**421.084**	**496.292**	**578.887**	**687.431**	**786.299**	**874.636**	**959.605**

Table no.4
Calculation of IRR Financial

Specification	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
INPUTS										
Income from project financing	0	0								
Income from operations		115.000	115.000	120.750	126.788	133.127	139.783	146.772	154.111	161.817
Residual value										
Total inputs	**0**	**115.000**	**115.000**	**120.750**	**126.788**	**133.127**	**139.783**	**146.772**	**154.111**	**161.817**
OUTPUTS										
Operation and	0	79.988	113.470	112.564	114.495	115.640	117.123	118.628	120.155	121.703

maintenance costs										
Investment costs	360.240	0	0	0	0	0	0	0	0	0
Total outputs	**360.240**	**79.988**	**113.470**	**112.564**	**114.495**	**115.640**	**117.123**	**118.628**	**120.155**	**121.703**
Cash flow	-360.240	35.012	1.530	8.186	12.293	17.487	22.660	28.144	33.956	40.113
Net Cash flow	**-360.240**	**35.012**	**1.530**	**8.186**	**12.293**	**17.487**	**22.660**	**28.144**	**33.956**	**40.113**
The discount rate **5%**										
The discount factor (a=5%)	0,952	0,907	0,864	0,823	0,784	0,746	0,711	0,677	0,645	0,614
Net present value	-343.086	31.757	1.322	6.735	9.632	13.049	16.104	19.049	21.889	24.626
Revenues to date	0	104.308	99.341	99.341	99.341	99.341	99.341	99.341	99.341	99.341
Costs to date	343.086	72.552	98.019	92.607	89.710	86.292	83.237	80.292	77.453	74.715

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INPUTS										
Income from project financing										
Income from operations	169.907	178.403	187.323	196.689	206.523	216.850	227.692	227.692	227.692	227.692
Residual value										
Total inputs	**169.907**	**178.403**	**187.323**	**196.689**	**206.523**	**216.850**	**227.692**	**227.692**	**227.692**	**227.692**
OUTPUTS										
Operation and maintenance costs	123.275	124.507	125.752	128.484	131.316	134.254	119.148	128.824	139.355	142.724
Investment costs	3.000	0	0	0	0	0	0	0	3.000	0
Total outputs	**126.275**	**124.507**	**125.752**	**128.484**	**131.316**	**134.254**	**119.148**	**128.824**	**142.355**	**142.724**
Cash flow	43.633	53.895	61.571	68.205	75.207	82.595	108.544	98.868	85.337	84.969
Net Cash flow	**43.633**	**53.895**	**61.571**	**68.205**	**75.207**	**82.595**	**108.544**	**98.868**	**85.337**	**84.969**

The discount rate **5%**										
The discount factor (a=5%)	0,585	0,557	0,530	0,505	0,481	0,458	0,436	0,416	0,396	0,359
Net present value	25.511	30.011	32.652	34.448	36.176	37.838	47.357	41.082	33.771	30.499
Revenues to date	99.341	99.341	99.341	99.341	99.341	99.341	99.341	94.611	90.106	81.728
Costs to date	73.830	69.330	66.689	64.893	63.165	61.503	51.984	53.529	56.335	51.230
IRR Financial	0,54%									
NPV	150.422									
Benefice/cost ratio	1,088									

The methodology used to assess the proposed project's contribution to economic and social welfare of the local environment as well as to the region and the country consists of:

- converting market prices used in the financial analysis accounting prices to correct price distortions caused by imperfections of market mechanisms;
- evaluation and inclusion in the analysis of externalities that lead to social costs and benefits that were not considered in the financial analysis;
- in assessing inputs and outputs, value added tax and social security payments were excluded from the calculation.

To assess the cash flow of economic analysis to use a standard conversion factor SCF = 0.84.

In the economic analysis identified a number of positive and negative externalities that influence directly or indirectly the project.

The economic analysis was considered as positive externalities:

1. Direct socioeconomic benefits: additional wages for labor employed during execution (40 people with an average monthly salary of 1,000 lei);

2. Annual benefit limit spending

3. Indirect socioeconomic benefits:

• income parents use the active labor force;
• revenues from increased efficiency in the organizations pharmaceuticals;
• revenues from reducing the incidence of specific diseases.

The economic analysis of the project were considered as the main negative externalities:

- the opportunity cost for the space provided by local authorities;
- specific cost of waste collection.

Table no.5

Results of efficiency indicators for economic analysis of the project

Indicator	Value
Internal Rate of Return (IRR)	**17,29%**
Net Present Value (NPV) (lei)	**918.228**
Benefice- cost ratio ($R_{B/C}$)	**1,42**

The project of making a nursery is proving to be effective in terms of its contribution to the national economy. Therefore justify project funding from national public funds.

5.Conclusions

Cost-benefit analysis of construction projects highlighted a number of features especially the case study on the construction of a nursery. The most important features that appear in cost-benefit analysis of construction projects are high during operation which can increase the uncertainty of future revenue and expenditure; difficult to quantify the revenues that are due exclusively to construction; reflecting the lack of technical progress in the period under review and how it affects the operating cycle and overhaul costs; the difficulty of estimating the post-use cost / income.

Therefore, in our opinion, cost-benefit analysis of construction projects is an especially useful tool for decision makers in the public domain but must be supplemented by other methods such as multi-criteria analysis . Given the degree of risk associated with long operational cycle is useful to use sensitivity analysis to reflect the impact on indicators for assessing potential risks to project effectiveness.

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