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Cost-Benefit Analysis – Economic Tool Used to Aid Decision-Making Regarding the Distribution of Public Funds

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Abstract:

After 1990, the financial analysis of the phenomena that occur in firms has grown in importance. Financial analysts face new challenges as a result of Romania's accession to the European Union. A thorough analysis of the investment decisions is required in order to access structural funds. Many projects that may be granted funds are not feasible from a financial point of view, generating economic and social implications. To demonstrate that the demanded funds are truly needed, the analyst has to identify and quantify as precisely as possible all costs and benefits generated by that specific investment, task which may be accomplished with the use of Cost-Benefit analysis. For this reason, in the following pages, we shall present the main methodological aspects of the method accompanied by an example of how it is used.

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The Cost - Benefit Analysis is a tool at the disposal of decision-makers, its goal being that of facilitating an efficient distribution of society's resources. It is an economic assessment which compares the costs and benefits of two or more

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alternatives to achieve an investment, both costs and benefits being transformed into monetary units. Costs must include the price of acquiring the equipment and the operating costs (maintenance, operator's training courses, consumables etc.) and also the opportunity cost. Some benefits are quantifiable (additional profit, loss decreases). Others, however, are harder to quantify. It is hard to transform into monetary units, for example: time savings, increases in employees' satisfaction or the growth of the population's living standard.

This method was first used at the beginning of the twentieth century in the United States of America to evaluate the projects regarding irrigations and the prevention of floods. After 1970, it was adapted and used to evaluate other projects, mostly those with public funding and that influence the environment (nuclear energy plants, refineries, airports, highways etc.). The use of Cost-Benefit Analysis for projects with public funding has been made compulsory through the step by step introduction by the governmental authorities of new pieces of legislation.

Large amounts of money are needed in order to develop the existing infrastructure in Romania and to reduce the gap between our country and other European Union members. Part of the sums will come from the Structural Funds allocated by the European Union. Cost-Benefit Analysis comes to the aid of the public decision-maker to identify the projects which will maximize social benefits and thus establish the order of priorities according to which work on infrastructure-related projects will commence. For this reason, through the Government's Decision no. 28/2008 regarding the approval of the technical and economic documentation framework and contents for public investments, the public authorities make the Cost-Benefit Analysis compulsory for public investments. It is included in the Feasibility Study.

The objectives of a Cost-Benefit Analysis for a public investment financed through European funds are the following:

- to determine the extent to which the project is in accordance with the regional development policy and especially the extent to which it contributes to achieving the main objectives for which the funds are requested;
- to determine the extent to which the project needs co-funding from EFRD in order to become viable from a financial point of view.

Cost-Benefit Analysis must not be mistaken for Revenue and Cost Analysis, which allows the selection of the most appropriate project only from a financial point of view. The analysis must take into consideration the financial implications but also the economic, environmental, social and technological implications. For this reason, the Cost-Benefit Analysis has the following components:

- financial analysis;
- economic and social analysis;
- risk and sensitivity analysis.

Financial analysis seeks to calculate the financial performance indicators of the project (its profitability). The method used is that of the "net discounted cash flow". First, the costs of the investment, the operating costs and the revenues

generated by the investment are estimated. Afterwards, the net cash flow is estimated. In the process of its determination, the depreciation and provisions are not taken into consideration.

Table 1 shows the recommended periods for which the assessment should be made for projects financed through Structural Funds. The values in this table are recommended values only; they may be reconsidered depending on the size of the project.

We shall use a project to build a **Medical research laboratory** financed through Structural Funds as an example in order to present the way the method is applied.

Investment costs were estimated at 550,000 euros.

Operational costs are composed of:

- the cost of specific materials (chemical substances, water filters, anesthetic substances etc.);
- the cost of electricity needed to operate the equipment and in order to ensure the illumination of the laboratory;
- research and auxiliary personnel-related expenses;
- maintenance and equipments fixing costs;
- other operational costs (phone services, bank fees etc.).

For the first year, these costs were estimated to be 97,955 euros. They are expected to grow by 2% on a yearly basis because of inflation. The established assessment period is 15 years.

Financial revenues are generated by the results of the research. The results are patented, training courses are organized and books that contain the results of the research are edited. For the first year the financial revenues are estimated at 98,000 euros. Therefore, the financial revenues surpass the operational costs of the project.

On the basis of these predictions the main financial performance indicators of the project may be calculated. These indicators point out the efficiency of the Laboratory's overall activity, the efficiency of the management of human resources and other assets, the obtained profit etc.

The main performance indicators for the Medical research laboratory are the following:

- *The net cash flow* generated by the project, calculated by the difference between cash inflows and outflows;
- *Investment efficiency*, which emphasizes the obtained results of the investment. This indicator may be determined in two ways: by dividing the total income by the initial value of the investment, or by dividing the net cash flow by the value of the investment.

$$E = \frac{\text{Total income}}{\text{Investment value}} \times 100 \quad (1)$$

$$E = \frac{\text{Net cash flow}}{\text{Investment value}} \times 100 \quad (2)$$

The level of these indicators has been determined for the first three years of the assessment period, as at the end of this interval the income and expenses become stable. The results are presented in table 2.

We can see that in each of the three years considered the incomes are higher than costs, which leads to a positive cash-flow. Still, the cash-flow generated by the project is very small and will not allow the recovering of the initial investment.

The efficiency of the investment has grown based on incomes and profit. In this way, the efficiency has grown from 17.82% in the second year till 18.54% in the fourth year. Due to cash-flow, the efficiency is very low (0.01%).

Based on the cash-flow generated by the project, a series of indicators can be determined in order to characterize the financial feasibility of the investment, as:

- financial Net Present Value (NPV);
- financial Internal Rate of Return (IRR);
- Cost Benefit Rate (CBR).

Net present value (NPV) is the indicator most used to characterize the efficiency of the investment. It is set as difference between the present cash-flows and the investment cost:

$$NPV = \sum_{t=1}^{n} \frac{F_t}{(1+i)^t} \quad (3)$$

t - considered prevision horizon;

F_t – cash flow of *t* year. To mention that the cash flow afferent of realization period of investment includes also payments for its realization;

i - discount rate.

The discount rate is used to bring flows of incomes and payments from moment *t* to moment *0*, for assuring their comparability with payments necessary for objective realization. Usually it is equal with opportunity cost of capital. In concordance with "Guide for cost - benefit analysis of investment projects" made by European Union, indicative for 2007-2013 period can be taken in consideration a real rate of 5% as reference parameter for opportunity cost of long term capital, which determined us to use this level in the calculation of net present value.

For the investment objective to be considered acceptable, from financial point of view, it is necessary that the net present value to be positive.

Financial internal rate of return (IRR) is defined as that discount rate for which net present value is zero. A favorable situation it is recorded when the level of this indicator is bigger than the one of the discount rate.

Cost-benefit rate (CBR) compares for every year of the horizon of prevision the operational costs and the incomes generated by the project. Its level it is calculated with relation:

$$CBR = \frac{\text{Expenses}}{\text{Incomes}} \quad (4)$$

A favorable situation is when this rate is less than 1, meaning the objective capacity to produce enough financial incomes to cover operational costs and even to obtain a financial surplus.

In considered example, for all period of prevision incomes are a little bigger than expenses, this means that the incomes generated by the project will cover the operation costs, but will not allow recovery, from financial point of view, on initial investment.

Net present value is negative as – 523,335 Euros that means the initial investment is not financial covered by cash flows produced by objective. In these circumstances, investment financing through private funds (own sources or banking loans) is not possible, the only one alternative is financing through non-reimbursable funds.

The financial internal rate of return is the discount rate which for the net present value is zero. In order to determine its level, we used *the successive approximation method*. By calculating the net present value for different values of the discount rate, the values from table 3 are achieved.

We observe that the net present value is zero for a discount rate between -45% and -45.1%. Thanks to near values we adopt in analysis a level of IRR as – 45.1%.

Cost - benefit rate tends to 1 for every year of the horizon of prevision. This means that financial incomes obtained will cover operation costs, but will not allow the investment recovery.

Financial analysis isn't enough to complete point out the real utility and benefits of the project, its contribution at welfare of a region or local community, as well as its connoted effects. For astound this aspects it should be completed with economical and social analysis, having the role to identify indirect beneficiary of projects and to quantify effects on these.

The economic and social analysis estimates the project's contribution to the economic welfare of the region and it is realized from the point of view of the entire society. Starting with the financial, economic and social analysis, through the appropriate conversion factors for each of the input or output flows, identifies the economic and social costs produced by the project.

The economic and social analysis implies the crossing through 3 stages:

Stage 1: Fiscal Corrections;

Stage 2: Corrections of the externalities;

Stage 3: The Conversion of the Market Prices into Accounting Prices.

Stage 1: Fiscal Corrections

This stage consists of the elimination of some fiscal distortions (taxes, subsidies) that affect the prices of the inputs and the outputs, respective:

- The elimination of the VAT and other indirect taxes of the inputs and outputs prices. The direct taxes included in the prices of the inputs will be maintained.
- The elimination of the transfer operations made towards natural persons (e.g. the payments for the social security).

Stage 2: Corrections of the externalities

This has as an objective the determination of the external benefits and of the external costs, which haven't been taken into consideration during the financial analysis. Although these might be easily identified, they are hard to quantify, and in this situation they have to be enumerated in order to offer to the decision maker additional elements to formulate the decision. As a general rule, every cost or social benefit that is spread abroad other subjects without compensation have to be book kept in this stage.

We must specify that these benefits may appear not only for the direct users of the project but also for third parties which haven't been taken into consideration from the very start.

Stage 3: The Conversion of the Market Prices into Accounting Prices

This proceeding has to establish the conversion factors for the conversion of the market prices into accounting prices. It is necessary such a conversion because the prices in use of the inputs and outputs can not express their social value because of the distortions on market (policy of exclusivity, barriers to entry etc.) and this thing changes the results of the analysis. The accounting prices come in order to solve out such a problem, because they eliminate such distortions and reflect the costs of social opportunity of the resources. They can be represented by the marginal cost of the goods that can not be commercialized on an international market, specially the price in the custom for the goods that can be commercialized on the international market.

The conversion of the market prices into the accounting prices is made with the use of the conversion factor. The standard conversion factor (SCF) is determined with the relation:

$$SCF = \frac{I(CIF) + E(FOB)}{[I(CIF) + Ti] + [E(FOB) + Tx]}, \quad (5)$$

where:
I (CIF) - CIF import;
E(FOB)- FOB export;
Ti- import duty taxes;
Tx- export duty taxes.

In this stage we must point out also the distortions that may interfere in the level of the salaries because of the imperfections of the labor market. The supplementary staff employment is at the first sight a supplementary social cost because it implies the use of the labor power resources in the project which become unavailable for other alternative activities. In the same time, the new jobs will generate a supplementary input that must be taken into consideration for the estimation of the outputs. This is why, in order to estimate the social effects of the new jobs creation, we can resort to two modalities:

- either it is used an accounted salary that is inferior to the present salary paid by the project that is justified by the fact that in the conditions of a

sub-utilization of the labor power, the paid salaries are bigger that the opportunity cost of the labor;

- either it can be tried in the estimation of the multiplier income of the output due to the positive external impact.

In the considered example, in the context of the fiscal corrections we have proceeded to take out the VAT from the prices of the inputs and outputs. And also there are not taken into consideration transfer operations towards individuals.

The corrections on the externalities hint the part of benefits generated by the project.

The external benefits generated by this objective are extremely diverse, and some of them are difficult to estimate. Among the external benefits generated by the implementation of the project we can remind:

- the reduction of the economic and social costs that are bound by the surgical treatment of the patient;
- the reduction of the costs that are bound by the training of the doctors and auxiliary personnel, and also the increase of their performances;
- the stimulation of the regional, national and international cooperation in this field;
- the social and economic environment will be improved by the increase of the medical performance, by the reduction of the hospitalization and of the temporary incapacity of work;
- the elimination of costs for the movement of the doctors for studies in other centers;
- the reduction of the costs for the patients' movement, for cure in other centers.

The project's implementation will provide a series of reductions of the costs concerning the hospitalization and the medication for the patients that will be constituted in external benefits for society, among which we can remind:

- the reduction of the days for the hospitalization for the patients cured by the "Affection 1" or "Affection 2". It is estimated the reduction of the number of days of hospitalization with 50% against the current situation, with a cost of 260 RON/hospitalization and an average annual number of 50 beneficiary patients for each affection;
- the reduction of the expenses with the medication for the same patients based on the reduction of the number of days of hospitalization, keeping in mind a medium cost of 150 RON/day;
- The reduction of number of analyses necessary for establish the diagnosis. Nowadays one needs two analyses to establish the diagnosis: NMR which costs 500 RON/analysis and CT which costs 350 RON/analysis. These will be made by one analysis only made with the help of the equipments from the Laboratory, with a cost of 100 RON/analysis.

The detailed calculus of the cost reductions obtained by the implementation of the project is presented in table 4.

We can observe that by the reduction of the number of days of hospitalization it can be obtained a reduction of 156,000 RON for the second year, respectively 44,571 Euros for a rate of 3.5 RON/Euro. By the reduction of the

payments for the medication, the reduction of the costs is 90,000 RON, respectively 25,714 Euros, and by the reduction of the number of necessary analyses there result savings of 37,500 RON, respectively 10,714 Euros. As a whole project, the external benefits generated by the project are estimated at the level of the second year at 81,000 Euros, with a growth of 2% per year as a result of inflation.

For the conversion of the market prices into accounting prices we have determined firstly the standard conversion factor. For the calculus of this factor we used the data regarding the imports, exports and taxes from the customs at 12/31/2006, provided by the National Institute of Statistics, respectively "the execution of the national budget at 12/31/2006"provided by the Ministry of Public Finances:

- CIF imports 45,539,229 thousand Euros;
- FOB exports 31,686,857 thousand Euros;
- Ti 215,543 thousand Euros;
- Te 14,514 thousand Euros.

The standard conversion factor for these values is 0.997.

The adjustment of the market prices will be made on types of expenses.

The imported equipments will be taken from companies from European Union so the taxes from the customs will be 0. The used conversion factor is 1. The furniture will be obtained from the internal market, and the standard conversion factor will be applied to them. The implementation of the project does not need costs for manual labor, so we won't have a correction on these. The different expenses have as correspondent some taxes and commissions that don't generate a consumption of resources and this is why they have to be eliminated from the total costs from the economic analysis.

For the operational costs one can make the following adjustments:

- the costs for the goods for consume, the energy, the maintenance and the fixings are adjusted by the application of the standard conversion factor, because their level is relatively important in the costs' structure;
- the costs with the personnel will be reduced with the unemployment rate from the region in order to reflect the opportunity cost of the human resources;
- other operational costs will not be corrected.

As compared with the financial analysis, the economic costs are smaller. Thus, for the second year, the fiscal corrections due to the VAT elimination have led to the costs' reduction with 4,103 Euros. The externalities don't generate supplementary costs. The conversion of the market prices into accounting prices generated reductions of the economic costs with 2,133 Euros in the first year and then with 5,027 euros in the second year, with a growth of 2% in the following years. On the whole, in the second year the economic costs are smaller than the financial ones with 9,130 Euros.

The economical benefits are bigger than the financial ones, due to the reduction of the number of days of hospitalization, the reduction of the costs with

the medication and the reduction of the number of necessary analysis. On the whole, in the second year the economical benefits are bigger with 90,174 Euros, rising till 116,650 Euros in the last year of prognosis (the 15th year).

Starting with the benefits and the economic costs generated by the project we have calculated the indicators of economical performance: the economic net present value (ENPV), the economical rate of the return (ERR) and the economic benefit-cost rate. For the calculus of these indicators we have used a discount rate of 5.5%.

The ENPV is of 400,034 Euros that means that from the economic point of view the investment can be made, the economic benefits are much bigger than the economic costs and they allow the recovery of the initial investment.

The ERR has increased till 15.6% and it is bigger than the one obtained in the financial analysis, but also bigger than the used discount rate, and this confirms the conclusion formulated before.

The cost-benefit rate has a constant level of 0.50, a situation favorably accepted.

As a conclusion, we notice that the results obtained by the economic analysis are much better than the ones obtained by the financial analysis, and the objective proposed for financial analysis is available in an economic point of view, even if from a financial point of view the calculated indicators have registered negative values.

The risk and sensitivity analysis has as purpose the identification of the parameters and of the critical variables of the model, whose variations, in a rapport with the values used when estimating the indicators of appreciating the efficiency of the investment, have the greatest effect on the NPV and on the Internal Rate of Return. In order to estimate the economical, social and environmental impact of the project, one operates with hypotheses, and this induces a series of uncertainties. This is the reason which for the risk and sensitivity analysis must be included in the CBA. The sensitivity analysis has been made both for the financial analysis and for the non-financial analysis.

The risk and sensitivity analysis for the financial analysis aims the determination of the economical and financial efficiency of the investment, when two extreme cases occur:

- the increase of the operational costs with X%;
- the reduction of the incomes with X%.

In the given example, we have taken into consideration a percent of increasing of 10% for the operational costs, respectively for the reduction of the incomes. The value of 10% if realistically appreciated, taking into consideration the modality of expressing and quantifying the investment's costs and the incomes and of the low risks estimated in what concerns the investment's realization. These are expressed in Euros, a stable currency from the point of view of the market's distortions, and the annual values of these indicators are aligned to the inflation's annual evolution of the unique European currency.

In the hypothesis of the expenses' growth with 10%, the operation costs will be bigger than the financial incomes. The NPV is negative, of -627,066 Euros, which means that initial investment can not be covered by the financial

incomes directly generated by the project. In these circumstances, the investment can't be financed by private funds (own sources or bank loans), the only possibility is the financing by non-reimbursable funds. The Intern Rate of Return can't be calculated because the cash flow is negative for every year. The cost-benefit rate is over 1 for all the considered years, so the incomes aren't sufficient to cover the expenses. Starting with the second year, its level becomes stable at 1.1.

In the hypothesis of reducing the incomes with 10%, the NPV is -667,114 Euros, being also negative, the financial direct incomes generated by the project are not sufficient to cover the investment. The IRR can not be calculated because of the negative cash flow. The cost-benefit rate is 1.11 in the second year, and it remains constant for the entire period of prognosis.

Using the obtained results after the financial analysis is applied, we can appreciate that, from a financial point of view, the project can't be sustained, and it generates enough incomes to cover the operational costs, but not to recover the initial investment. The NPV and the IRR have negative values, that make impossible the investment's financing from private funds (own resources or bank credits), the only possibility being the financing from non-reimbursable funds.

Keeping in mind that from the financial point of view the project is not viable, but it generates enough economical benefits so as to justify the financing of the investment, carrying out ***the risk and sensitivity analysis for the economic and social analysis*** is imposed. When making this analysis, two variants were taken into consideration:

- the growth of the total economical costs (excepting the ones concerning the investment's realization) with 10%;
- the reduction of the economical benefits with 10%.

For each hypothesis we have calculated the indicators of performance, respectively Net Present Value and the Internal Rate of Return.

In the hypothesis of costs' growth with 10%, ENPV is 309,475 Euros, and ERR represents 13.5% while the incomes' reduction with 10% leads us at a level of the ENPV of 217,541 Euros, respectively 11.3% for ERR, which means that the risks of the project are low.

More than this, the risk and economical sensitivity analysis let us obtain, by implementing the project, some economical and social benefits bigger than the financial ones, which justifies the financing of the investment by non-reimbursable funds.

The importance of the Cost-Benefit Analysis for determining the global economical efficiency of an investment project consists in pointing out some categories of costs and benefits, considered as being indirect and which as usually are not taken into consideration in the financial analysis of the investment project. This is due either to the lack of a law to regulate this thing, either because it is difficult to quantify the impact on the environment and the connected effects.

References

1) Boardman, A., Greenberg, D., Vining, A., Weimer D., 2004, "The Cost-Benefit Analysis", ARC Publishing House, Bucharest.
2) Buşe, L., Siminică M., Cîrciumaru D., Marcu N., 2007, „Analiza economico-financiară a firmei", Ed. Sitech, Craiova.
3) Florio, Massimo, 1997, "Guide to cost-benefit analysis", Evaluation Unit DG Regional Policy European Commission.

APPENDIX

Table 1: Recommended assessment periods by project type

Field	Period
Ports and airports	25 years
Roads (county roads)	20 years
Roads (rural roads)	10 – 20 years
Industry (including tourism)	10 years
Forests and parks	25 years
Industrial and technological areas	20 years
Hospitals and health-related infrastructure	20 years
Museums and archaeological parks	15 – 20 years
Education/training-related infrastructure	15 -20 years
Other services	15 years

Table 2: The financial performance indicators of the project

Indicator	**2nd year**	**3rd year**	**4th year**
Total income	98000	99960	101959
Total expenses	97955	99914	101913
Investment value	550000	550000	550000
Net cash flow	45	46	47
Investment efficiency	*	*	*
- Total income / Investment value	17.82	18.17	18.54
- Net cash flow / Investment value	0.01	0.01	0.01

Table 3: Calculation of internal rate of return

Discount rate	Net present value
- 44%	- 213,005
- 45%	- 13,571
- 45,1%	+ 9,758

Table 4: The calculation of the cost discounts after implementing the project

Explanations	Days of hospitali-zation without the project	Days of hospitali-zation with the project	Reduc-tion	Cost / day	Cost / patient	No of patienti / year	Reduc-tion from the total cost (Ron)	Reduc-tion from the total cost (Euro)
1. Red. of the no. of days of hospitalization	*	*	*	*	*	*	*	*
Affection 1	15	8	7	260	1820	50	91000	26000
Affection 2	9	4	5	260	1300	50	65000	18571
Total reduction	*	*	*	*	*	*	*156000*	*44571*
2. Red. Expenses with the medication	*	*	*	*	*	*	*	*
Affection 1	*15*	8	7	150	1050	50	52500	15000
Affection 2	*9*	4	5	150	750	50	37500	10714
Total reduction	*	*	*	*	*	*	*90000*	*25714*

3. Reduction of the no. of necessary analyses	Cost / analysis (Ron)	No. of patients	Total cost Ron	Total cost Euro
WITHOUT THE PROJECT	*	*	*	*
- RMN	500	50	25000	7143
- CT	350	50	17500	5000
CU PROIECT	100	50	5000	1429
Reduction of costs	*750*	*	*37500*	*10714*