Cost – Benefit Analysis for Public E-services Investment Projects

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Abstract: Cost-benefit analysis is considered to be one of the most efficient tools in order to quantifiy the neccessity and oportunity of an investment project. The main advantage of this method is that it can be very easily utilised in practical situations. Nevertheless using cost-benefit analysis has to take into account the specific elements of the analyzed project in order to ascertain the appropriate conclusions.

Public e-services investment projects are a special type of investment projects that do not generate any incomes and are subject to non-reimbursable funding from existing financing programs. These particularities imply some adaptations to the classic cost-benefit analysis methodology.

Key words: cost-benefit analysis, European funds, public e-services, non-reimbursable funding.

1 Introduction

In 2007 Romania joined the European Union and started to benefit from the non-reimbursable European funds in order to reduce the gap between its economy and those of the other member states in the EU. One of the areas where the gap is most significant is the Information Technology and Communication (IT&C) domain. This area is identified and financed by the "Increase of the Economic Competitiveness" Operational Sectorial Program 2007-2013 (POS CCE).

This financing program identifies a Prioritary Axis in order to finance the IT&C investment projects: Prioritary Axis 3 – "Information technology and communications for the public and private sector". This financing axis, through its three major intervention domains, it supports the economic competitiveness and promotes the interaction between the public sector and enterprises/ citizens by capitalizing on the IT&C potential.

The e-services investment projects are financed by the Major Domain of Intervention 2 – "The

development and increase of the efficiency of the electronic public services". There are four categories of projects identified to be financed, so there are four financing operations.

The objective of these financing operations is to make available services by using electronic means and to create benefits both for the users and for the public entity that provides the services.

2. Problem Formulation

One of the most interesting regulations is the one presented regarding the e-government investments. These investment projects that are financed by the Operation 1 – "Support for the implementation of e-government solutions (including e-administration) and provision of broadband connections", have to provide at least one public service for the citizens/ business enterprises/ public administration at a minimal level of sophistication 3.

The five possible levels of sophistication are:

- Posting information online;
- Unidirectional interaction: the existence of online forms to be downloaded;
- Bi-directional interaction: the possibility to transmit online the filled forms;
- Complete electronic transactions, including delivery and/ or payment;
- Personalization and pro-activity – it reflects the degree to which the available online services respond to the users' needs.

The 5th level of sophistication includes two new concepts:

- The pro-active delivery of services, which means that the public administration takes action in order to improve on the quality of the provided services and on the attitude towards the user. Pro-activity examples: raising awareness in the users regarding certain measures which they have to take, pre-completion of some of the form's fields with data already existent in the public administration's databases;
- The automatic delivery of the service: the public authorities automatically deliver certain economic or social services that are rightfully due to the citizen/business enterprise, without them needing to request these services.

This financing operation has two main objectives that must be addressed simultaneously:

- *To deliver on-line public services* to the citizens/ business enterprises/ public administrations;
- *To increase by using IT&C means the effectiveness of the public institution's internal processes* which contribute to the provision of the fore mentioned services.

Regardless of the financing operations, which essentially means regardless of the type of e-service provided, the dossier that comprises the specific documentation in order to obtain non-reimbursable funding includes a feasibility study with a cost-benefit analysis chapter.

The cost-benefit analysis of an e-services investment project implies the following steps:

1. The identification of the investment and definition of the corresponding objectives, including the specification of the reference interval;
2. The options analysis;
3. The financial analysis;
4. The economic analysis;
5. The sensitivity analysis;
6. The risk analysis.

The cost-benefit analysis structure is regulated by the Government Decision no. 28/2008 regarding the approval of the technical and economical documentation's content-framework for public investments, and of the structure and methodology for the general estimate for investment objects and intervention work, and later detailed by Order no. 863/2008. The legally regulated structure for the cost-benefit analysis is based on the structure provided by the Working Document no. 4 of the EC, but a major difference is that this European document mentions the use of the cost-benefit analysis for major infrastructure projects. The major projects are considered those projects whose values are larger than 25 M.Euro or 50 M.Euro for the environmental projects.

The Romanian legislation, as well as the Romanian European fund management authorities, failed to capture this essential recommendation, and impose in most cases the cost-benefit analysis regardless of the project's specifications.

This is also the case of the IT&C investment projects. This situation generated the necessity for establishing a methodology for the cost-benefit analysis for projects which do not need this analysis.

2.1 Cost-benefit analysis theory

Cost–benefit analysis is typically used by governments to evaluate the desirability of a given intervention. It is an analysis of the cost effectiveness of different alternatives in order to see whether the benefits outweigh the costs. The aim is to gauge the efficiency of the intervention relative to the status quo. The costs and benefits of the

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impacts of an intervention are evaluated in terms of the public's willingness to pay for them (benefits) or willingness to pay to avoid them (costs). Inputs are typically measured in terms of opportunity costs - the value in their best alternative use.

The process involves monetary value of initial and ongoing expenses vs. expected return. Constructing plausible measures of the costs and benefits of specific actions is often very difficult. In practice, analysts try to estimate costs and benefits either by using survey methods or by drawing inferences from market behavior.

The accuracy of the outcome of a cost–benefit analysis depends on how accurately costs and benefits have been estimated.

Another challenge to cost–benefit analysis comes from determining which costs should be included in an analysis (the significant cost drivers). This is often controversial because organizations or interest groups may think that some costs should be included or excluded from a study.

$$(1)\ NPV = -I_0 + \sum_{i=1}^{n} \frac{CF_i}{(1+r)^i} + VR_n$$

According to the accepted theoretical, the cost-benefit analysis can be performed by using one of the following relationships:

- If the implementation of the projects is already finished or has a very short term:

$$(2)\ NPV = -I_0 + \sum_{i=1}^{n} \frac{CF_i}{(1+r)^i} + \frac{VR}{(1+r)^n}, \text{ where:}$$

i - the evaluation period;

n - the forecasting period;

I_0 - the investment value (not discounted);

CF_i - the cash-flow value in period i (not discounted);

r - the discount factor;

VR - the residual value (not discounted).

- If the implementation of the project is spread over more than 1 period:

$$(3)\ NPV = -\sum_{k=1}^{m} \frac{I_k}{(1+r)^m} + \sum_{i=m+1}^{n} \frac{CF_i}{(1+r)^i} + \frac{VR}{(1+r)^n},$$

where:

k - the implementation period;

m - the total implementation period;

i - the evaluation period;

n - the forecasting period;

I_k - the investment value in period k (not discounted);

CF_i - the cash-flow value in period i (not discounted);

r - the discount factor;

VR - the residual value (not discounted).

Using one of the presented calculation relationships, one can calcule the Net Present Value of the Project. If the obtained value is positive, the evaluated project is worth implementing, but a further analysis is needed using another indicator, the Internal Rentability Rate (IRR).

IRR is calculated as the discount factor that makes the NPV equal to zero. If the NPV value is positive, the IRR is larger than the discount factor employed in the analysis.

This indicator can be compared to a target value, and it the obtained value is larger than the target value, than the project is worth implementing.

These two indicators are not the only ones that are used to decide, but due to their large informational value, are two of the key indicators taken into consideration.

3. Problem Solution

The cost-benefit analysis for e-government projects implies an adaptation of the given regulations, alternative which is presented in detail in this chapter. There is also a numeric example presented.

The first stage of the analysis is **the identification of the given project and the definition of its objectives**, also specifying the reference interval for the analysis.

E-services projects are projects that aim to implement an integrated informatics system by a public service provider. This system will provide online public services to the users and will ensure an increase in the efficiency of the internal data processes associated to these services. By correctly identifying the project to be implemented, the defined objectives of this project are also specified:

- To provide public services using electronic means;
- To facilitate the access of the users to the public services provided by the implementing public service provider;
- To increase the efficiency of the activity of the public service provider.

Choosing an appropriate reference interval for the cost-benefit analysis is a very important step. In this case, the reference interval is considered to be 10 years after the implementation of the project. This interval is considered to be sufficient for observing the financial coordinates of the project.

The next step in the cost-benefit analysis is **the option analysis**. This analysis starts with the identification of the existing/ possible options. The options are essentially different ways to ensure the fulfillment of the announced objectives of the project. The choice of the options to be analyzed

implies taking into account possible and probable scenarios, some of which are presented next:

- The first option to be considered is not to implement the project, which means that the situation remains unchanged for the entire reference interval, no costs or benefits being produced;
- The implementation of the project with non-reimbursable financing, and in this case there can be taken into account the various technical and functional alternatives;
- The implementation of the project without the non-reimbursable financing.

The difference between the last two options resides in the financial constraint placed upon the implementing public authority/ institution/ administration. It is obvious that for the option that implies the non-reimbursable funding the financial performance indicators will take values corresponding to a much more favourable outcome.

The identified options will then be analyzed by using a decision criterion like the following:

- The lowest cost;
- The most advantageous technically;
- The most advantageous economically.

The first two decision criteria imply the one-dimensional analysis of the options by comparing them to each other considering their respective characteristic, be it the investment cost, or the technical performances of the analyzed system. The latter criterion makes possible a complex analysis of the considered options.

Considering "the most advantageous economically" criterion one, the decision-maker defines certain decisional characteristics that represent his view on the economical value of an analyzed option. These characteristics can be either minimal or maximal and each one has an associated importance coefficient that quantifies its subjective importance.

Each alternative is scored/ valued by the decision-maker taking into consideration each defined characteristic. Next, the scores are normalized using the following formulas, in order in ensure the possibility to summate them for each of the options:

- Minimum criterion

(4) $P(i,j) = (Vmax(i) - V(i,j)) * P(i) / (Vmax(i) - Vmin(i))$, where:

$P(i,j)$ = the score for criterion i of option j;
$P(i)$ = total points associated to criterion i;
$Vmax(i)$ = maximal value for criterion i;
$Vmin(i)$ = minimal value for criterion i;
$V(i,j)$ = value associated to criterion i for option j.

- Maximum criterion

(5) $P(i,j) = P(i) - (Vmax(i) - V(i,j)) * P(i) / (Vmax(i) - Vmin(i))$, where:

$P(i,j)$ = the score for criterion i of option j;
$P(i)$ = total points associated to criterion i;
$Vmax(i)$ = maximal value for criterion i;
$Vmin(i)$ = minimal value for criterion i;
$V(i,j)$ = value associated to criterion i for option j.

The obtained scores are summated and the total scores are compared. The chosen option has highest score, this option being the one that is the most advantageous economically for the decision-maker.

The chosen option is then subjected to a **financial analysis** in order to determine the financial performance indicators. Based on these indicators one can justify the necessity and opportunity of the project. The financial analysis implies the estimation of the benefits and costs and based on these estimations the net cash-flows can be calculated. The indicators to be determined are:

- Net Present Value;
- Internal Rate of Return;
- Benefit/Cost Ratio.

Analyzing the values of these indicators, one can draw conclusions regarding the necessity and opportunity of the investment:

- If NPV<0 this means that one the considered time interval the investment is not a profitable one, but if we are talking about e-government investment projects that do not generate any incomes, one can conclude that the investment is in dire need of non-reimbursable funding;
- If IRR has a smaller value than the discount rate, which is implicit if NPV<0, the conclusion is similar;
- If the Benefit/Cost Ratio is larger than 1, then the opportunity of the investment overweighs the associated costs, making this investment a very attractive one.

The next step in the cost-benefit analysis is **the economic analysis**, which aims to extend the conclusions formulated earlier based on the financial performance indicators. The financial analysis is extended by applying certain fiscal, externalities related and shadow-prices related corrections. For e-services investments this economic analysis is not needed and should not be performed because these projects are not major infrastructural projects and do not generate any additional incomes. Rather one can perform an analysis on the social and economic impact of the project, also describing the promotion methods based on the target audience. This description is essentially a qualitative economic analysis, highlighting the relevant social aspects.

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The project's key factors are identified in **the sensitivity analysis**, and for these key factors the financial performance indicators are recalculated in order to assess the impact of their variance.

If a modification of the key factors by 1% induces a modification of the indicators by more than 5%, those factors are critical variables of the project. The absence of any critical variables indicates a stable and well structured project.

The risk analysis refers to indicating the problematic areas of the project, aspects which can result in not implementing the project within the expected time or costs. The risks that have to be highlighted are: exceeding the expected costs, external dependencies, management risks.

Following this qualitative analysis one can perform a more quantitative analysis that requires the identification of the probability distributions for the critical variables of the project.

The example presented in this chapter will show how the cost-benefit analysis can be performed for public e-services investment projects. The option analysis and the financial analysis will be presented in detail, these steps being the ones where the analysis is quite specific.

The numeric example for the cost-benefit analysis starts with the second step, **the option analysis**. The following options/alternatives are taken into consideration:

- **Option 1** – the project is not implemented, the situation remaining as it is. In this case there are no costs, but also no benefits. The *number of implemented e-services* in this case is 0;
- **Option 2** – the project is implemented using the Technical Scenario 1 and benefits from the non-reimbursable funding. The Technical Scenario 1 is a scenario where the implemented system has slightly less features, but is also cheaper. The *number of implemented e-services* in this case is 6. The economic coordinates of this option are:
  - Total Project Value = 4.140.000,00 lei;
  - Subsystem 1 = 745.000,00 lei;
  - Subsystem 2 = 1.500.000,00 lei;
  - *Project Value considering the non-reimbursable funding = 1.220.000,00 lei*
- **Option 3** – the project is implemented using the Technical Scenario 2 and benefits from the non-reimbursable funding. The Technical Scenario 2 is a scenario where the implemented system has all the requested features, but is also more expensive. The *number of implemented e-services* in this case is 8. The economic coordinates of this option are:
  - Total Project Value = 4.765.000,00 lei;
  - Subsystem 1 = 835.000,00 lei;
  - Subsystem 2 = 1.690.000,00 lei;
  - *Project Value considering the non-reimbursable funding = 1.500.000,00 lei*
- **Option 4** – the project is implemented using the Technical Scenario 1 and doesn't benefit from the non-reimbursable funding. The Technical Scenario 1 is a one where the system has slightly less features, but is also cheaper. The *number of implemented e-services* in this case is 6. The coordinates of this option are:
  - Total *Project Value = 4.140.000,00 lei*;
  - Subsystem 1 = 745.000,00 lei;
  - Subsystem 2 = 1.500.000,00 lei;

Before moving on to the financial analysis the presented option have to be compared in order to determine which option is the best for the decision-maker, in this case the implementing public entity.

Each alternative is scored/ valued by the decision-maker taking into account some subjectively defined characteristic. They can be:

- *The number of implemented public services*, which is a positive impact indicator and it reflects in a maximal decision criterion.
- *The cost of subsystem 1*, which is a negative impact indicator and it reflects in a minimal decision criterion.
- *The cost of subsystem 2*, which is a negative impact indicator and it reflects in a minimal decision criterion.
- *The cost of project*, which is a negative impact indicator and it reflects in a minimal decision criterion. The project's cost is computed as the general social cost, comprised of the public entity's own financing effort and the value of the national contribution.

The values for the four considered criteria are:

Scoring criteria		UM	Indicator values			
			1	2	3	4
1	Implemented services	No.	0	6	8	6
2	Cost of subsystem 1	Lei	0	219,541	262,854	745.000
3	Cost of subsystem 2	Lei	0	442.029	532.004	1.500.000
4	Total project value	Mii Lei	0	1.220	1.500	4.140

Table 1.

The scores obtained for the four options using the defined characteristics are as follows:

Scoring criteria		Importance Coefficient	Indicator values			
			1	2	3	4
1	Implemented services	40	0	30	40	30
2	Cost of subsystem 1	20	20	14	13	0
3	Cost of subsystem 2	20	20	14	13	0
4	Total project value	20	20	14	13	0

Table 2.

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After concluding the option analysis, *Option 2 is the recommended alternative* for the project based on the decision-maker's profile. This is obviously the best alternative, an alterntive that has the lowest cost possible and yet the most of benefits that are worth paying for.

This result is perfectly justified considering the following aspects:

- This alternative has the lowest cost while also generating some of the desired benefits;
- Comparing Option 2, with the non-reimbursable funding, to Option 4, it is obvious that the non-reimbursable funding brings very serious benefits, especially at cost level;
- The project holds important benefits for the implementing entity and its employees.

The results of this analysis could have been very different by considering different decision criteria or modifying the importance coefficients associated to the criteria.

The next step in the cost-benefit analysis is **the financial analysis**. The goal of this analysis is to compute the three indicators that will base the conclusions regarding the selected option: Net Present Value, Internal Rate of Return and Benefit/Cost Ratio.

The public e-services investment projects do not generate any suplimentary monetary incomes. This is the case because these projects are essentially basic infrastructure and they are necessary because they contribute to a better quality of life.

Usually at this point, the incomes and the costs are determined, but since this projects generates no suplimentary incomes, the costs will be suported from the public entity's budget. This means that in order to compute the financial performance indicators we can ignore the incomes and costs.

The following calculations are made:

- **Net Present Value:**

It's an indicator that quantifies the project overall value on the chosen reference interval (10 years). The utilised formula is:

(6) $NPV = -IV + NIF + RV$, where:

NPV = Net present value;
IV = Investment value;
NIF = Net income flux (which is 0);
RV = Residual value.

The following assumptions are made:

- The discount factor is considered to be 5%;
- The residual value is considered to be 30% of the total actualised value of the investment:

$$(7)\ RV = \frac{IV \cdot 30\%}{(1+5\%)^{10}} = \frac{366.000}{1,6289} = 224.692\ lei$$

The Net Present Value is:

$$(8)\ NPV = -1.220.000 + 0 + 224.692 = -994.308\ lei$$

- **Internal Rate of Return**

The Internal Rate of Return is essentially the value of the discount rate that makes the NPV to be zero. Because the project doesn't generate any net incomes, this indicator *shouldn't be computed* since for any value assigned to the discount rate the Net Income Flux will be zero.

- **Benefit/Cost Ratio**

Because the project doesn't generate any net incomes, this indicator *can't be computed*.

The conclusion that can be drawn is that the project is necessary but can't be realised without the non-reimbursable funding.

The economic analysis aims to extend the conclusions formulated earlier based on the financial performance indicators. For e-services investments this economic analysis is not needed and should not be performed because these projects are not major infrastructural projects and do not generate any additional incomes. Rather one can perform an analysis on the social and economic impact of the project, also describing the promotion methods based on the target audience. This description is essentially a qualitative economic analysis, highlighting the relevant social aspects.

4. Conclusions

The purpose of the cost-benefit analysis resides in the need to assess the necessity and opportunity of an investment project. Even though there is a generally accepted methodology for performing such an analysis, applying in real life this methodology requires quite a great deal of effort.

Considered to be one of the most efficient tools for analyzing an investment project, the cost-benefit analysis was legally regulated, in order to take advantage of its benefits, without considering its purpose and essence. This is why, when using the cost-benefit analysis to analyze an public e-services investment, the specifics of the projects need to be taken into consideration with the outmost care.

The presented methodology can be extended and utilized for any investment project that aims to creating and/or improving online services.

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