1.02 Review article

The Social Cost-Benefit Analysis as Estimation Methodology: Case Study for Infrastructure Projects

UDK: 332.012.36

Samanta Petohleb Černeha*
IVS – Istarski vodozaštitni sustav d.o.o., Croatia
samanta.petohleb@ivsustav.hr

Maja Klun
University of Ljubljana, Faculty of Administration, Slovenia
maja.klun@fu.uni-lj.si

Srečko Devjak
University of Ljubljana, Faculty of Administration, Slovenia
srecko.devjak@fu.uni-lj.si

ABSTRACT

Local public investments are financed by budget funds (state, county, local), debt funds (loans or credits, municipal obligations) and non-debt funds (users' charges and methods and techniques of public-private partnership). In this paper some theoretical issues about cost-benefit analysis (CBA) and advantages and limitations in applying it are discussed. CBA is used in the public sector in making decisions where it is relatively easy to determine the costs, but the expected benefits can be difficult to express in monetary value. To ensure an equitable quantity of financial sources according to negative difference between inflows and outflows is one of the most important goals of the project. Based on theoretical framework about CBA, a calculation was made on social profitability of the project Public sewerage and water protection in the Region of Istria. The main conclusion of this paper is that if the project achieves the social profitability, net profit and high economic internal rate of return, it is possible to accept the realization of the project.

Key words: cost-benefit analysis, local public investments, social value of the project

JEL: C61, H72

* The article summarizes research results of doctoral thesis.

1 Introduction

Cost-benefit analysis (CBA) helps managers and other decision makers understand the cost and expected returns (in monetary value) of a given decision. It can help them decide whether or not to undertake a proposed activity, or choose between different alternatives. CBA tools make this analysis easier and more straightforward, for example, by graphing different alternatives or presenting data for comparison. In order to specify the structure of financial funds for the wastewater project as a case study in our research, a CBA was made and on the basis of its results a decision about acceptance or rejection of the project was reached.

The research problem is the insufficiently practically applied evaluation criteria and methods for economic assessment of infrastructure projects, with purpose to research and prove the social profitability of investment in the public sector. In order to adequately address the problem of research it was necessary to scientifically determine many topical issues such as: what is the social profitability of the project, what the criteria for evaluating investments are and what the projection of costs and benefits based on the CBA is. The empirical part focused on the project *System of public sewerage and water protection in the Region of Istria*. The main goal was to determine total costs and benefits that can be expressed in monetary value, to maximize their net present value and on obtained data and results make the decision on the realization of the project. Use of shadow prices is a key element of modern CBA and evaluators should use them for project appraisal.

The paper is structured as follows. After the introduction, the second part of the paper focuses on theoretical determinants of CBA. The third part is showing advantages and disadvantages of using CBA as estimation methodology of infrastructure projects. The fourth part applies cost-benefit analysis on the Project of public sewerage and water protection. The conclusion includes a short summary of the research.

2 The Theory of Cost-Benefit Analysis

CBA, except in a private enterprise, is useful in the public sector in making decisions about engaging financial sources in public finance projects, where it is relatively easy to determine the costs, but the expected benefits can be difficult to express in a monetary value (Layard, 1994). There were many articles and papers (Florio, 2007; Layard, 1994; Anandarup, 1990) about theoretical approach of CBA, but in literature is still insufficiently researched how to express benefits in monetary value. Unlike the market economy in which the realization of projects brings profit and the market value of inputs and outputs is used, there is different situation when we talk about the realization of public projects. Market prices of public projects do not exist because output of public projects (benefit) is not for sale. Therefore, the analysis of social costs and benefits is usually applied in the following

branches of public sector: transport, water supply and water management, defence, healthcare and education.

CBA in the public sector can be used for (Horvat, 1986):

- making rational budget decisions,
- evaluation of public sector output,
- maximizing net social benefits of public expenditures,
- comparison of costs and benefits and positive and negative effects,
- measurement of the rationality of resource allocation,
- evaluation of investment projects in the public sector,
- efficiency assessment of investment in infrastructure and human capital.

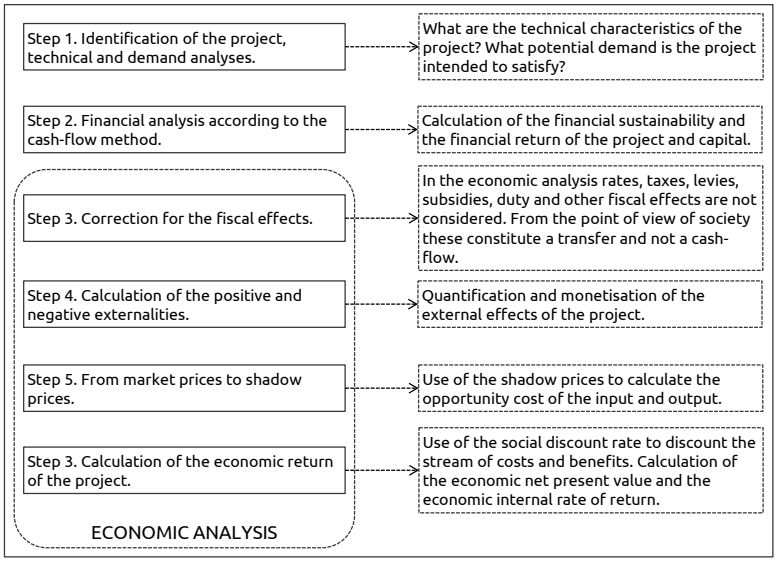
The aim of CBA is to maximize the present value of all social benefits minus costs (Anandarup, 1990). With CBA the present value of investments and social benefits of public projects are evaluated and compared in order to assess the validity of the project and to make decisions regarding their implementation. The costs and revenues (or benefits) from an investment project will extend from the present into the future (Dinwiddy & Teal, 1996).

Due to European Commission (2009) the cost-benefit analysis has three parts:

- a technical-engineering part (the context and technical characteristics of the project should be identified);
- a financial analysis which is a starting point for CBA and leads the analysis from the point of view of the private investor;
- as economic analysis, CBA is starting with the financial analysis that serves to identify all the income and outcome items and the relative market prices, applies a series of corrections (fiscal, externalities…) that allows us to pass from the point of view of the private investor to that of the public sector.

According to European Commission (2009) there are six steps to make an evaluation of the project using CBA as it can be seen in Figure 1.

Figure 1: Steps in cost-benefit analysis



Source: European Commission (2009).

CBA is successful if all mentioned steps are exanimated. All these steps were followed in the CBA used for our case study.

Net Present Value Method was used in capital budgeting to analyze the profitability of an investment project. With Net Present Value method a company decides whether or not accept the investment project:

$$NPV = \sum_{n=0}^{t} \frac{NI_n}{(1+\frac{p}{100})^t}$$

where we find:

NPV = net present value of the project,

NI_n = net inflows,

p = discount rate (in the case of capital infrastructure projects is called social discount rate),

n = last period in which is expected cash flow,

(1 + *p*/100) = *r*, which represents interest factor.

Criteria for evaluating the application of this method is as follows:

- NPV > 0 – the project is acceptable,
- NPV = 0 – the project is marginally acceptable,
- NPV < 0 – the project should probably be rejected because cash flows will also be negative.

The other method of discounted cash flows was the internal rate of return on an investment or project which is used in capital budgeting to measure and compare the profitability of investments. It is a discount rate that makes the net present value of all cash flows equal to zero (Veselica, 1995). Furthermore, it is equating the present value of expected expenditure with the present value of expected receipts:

$$\sum_{n=0}^{t} \frac{NCF_n}{(1+\frac{p}{100})^n} = o$$

where we find:

NCF = cash flow (receipts and expenditure) for the period *t*,

n = last period in which cash flows are expected,

p = discount rate.

In the project evaluation the economic internal rate of return is expected to be higher than the financial rate of return. Otherwise, the project is more convenient for a private investor than for the public sector. If there are considerable social benefits of a project that are not monetisable, the project is more convenient for the public sector.

As already mentioned the internal rate of return and the net present value, as methods of discounted cash flow analysis, have been calculated in economic analysis which is part of CBA for the selected case study. By using these methods, an evaluation of the investment efficiency of the project has been made.

3 Advantages and Limitations in Applying the Analysis of Social Costs and Benefits

The use of CBA for social evaluation of the project has many advantages and disadvantages, too. Advantages of CBA are: long lifetime (economic period) of investment project (for infrastructure projects in water, wastewater and environment the economic life considered 30 years), CBA includes direct and indirect economic, social and environmental impacts, benefits which can be measured in monetary value and intangible benefits (benefits which cannot be expressed in monetary value) are part of CBA and they are the base of social appraisal of the project. CBA helps politicians and investors to allocate their sources on the project until the marginal social benefit is higher than marginal social costs, decision making about acceptance and realization of the project is the most objective when it has used the criteria of net present value: the project is acceptable if his net present value is positive, the social rate of discount is lower than the discount rate because in the public sector decision makers have to care not only about present generations, but for future generations, too. Private entities will invest in projects of public interest when the profitability of project is high and when future generations

expect benefits of that project. European Commission (2009) described the advantages of the cost-benefit analysis as strengths, which shows that CBA enables us to express an opinion on the economic-social convenience of a project; enables us to create rankings among projects and encourages the practice of identifying the economic benefits and costs, even if they are not immediately monetisable.

At the same time we must consider also disadvantages and problems of CBA: accuracy of the information; distribution of justice is limited to evaluating the value which depends on political interests; compensatory payments are used for adjustment to reduce benefits of individuals and groups; discount rate can show possible preferences in the content of the project; determining the operational parameters in this regard is very difficult, in CBA it is difficult to determine the duration of the project, the time that will provide a net benefit of present and future generations, due to lack of market prices; the »shadow« prices or the social opportunity costs should be taken into account; external effects are not individually included in the price of the product and production factors. The disadvantages are also that CBA can lead to biased results in the decision because unrealistic effects are difficult to express in monetary value and CBA is founded on the marginality principles – a Pareto optimum has a key role in this. European Commission (2009) beside the mentioned advantages has described the limitations of the cost-benefit analysis, which shows that CBA does not take redistributive effects into consideration (for these a multicriteria analysis should be used); does not consider the effect on the economic return of non-monetisable benefits or costs and sometimes uses discretional criteria for the monetisation of the costs and benefits for which no market exists.

All costs and benefits have to be included into social CBA, such as private and social, direct and indirect, tangible and intangible. Benefits are based on the consumer's willingness to pay for the project. Costs are representing the amount the investors are willing to receive as compensation for giving up the resources. The social discount rate is used for discounting the annual net-benefit flow.

CBA is suitable for capital infrastructure projects which have besides direct and tangible benefits also indirect and intangible benefits during a long time period.

4 The Cost-Benefit Analysis on the Case Study of System of Public Sewerage and Water Protection in the Region of Istria

Because the project System of Public Sewerage and Water Protection in the Region of Istria is complex, expensive (a lot of sewerage systems for very small number of inhabitants) and has a very long time horizon (30 years), its beneficial impacts on the whole society and economic viability of

the project should be calculated by determining benefits created as a result of the implementation of the project. The main object of the project is the construction of the system of sewerage and wastewater treatment facilities in water protection zones in the Region of Istria and to organize a joined organization for control, construction and for maintenance of the sewerage systems.

Starting from the methodology of CBA it is necessary to evaluate the costs and overall benefits of capital infrastructure project System of public sewerage and water protection in the Region of Istria. The aim of the financial analysis is to appraise if the project's cash flow during 30 year period generates a suitable return by calculating financial internal rate of return, financial net present value and proving financial sustainability of the project. The financial analysis of the System of public sewerage and water protection includes total investment and operating costs, sources of financing, revenues, evaluation of the financial sustainability, calculation of financial internal rate of return and financial net present value.

Investment costs incur during the preparation and construction phase and they include:

1. Project development costs
   - Costs of design, planning and documentation
   - Costs of geological works and
   - Costs of land acquisition and expropriation.

   Total project development costs are estimated at 6.027 millions of EUR.
2. Building costs
   - Building costs of sewerage system
   - Building costs of wastewater treatment plant (WWTP) and
   - Contingencies.

   In building costs are calculated civil works and equipment of sewerage system and wastewater treatment plant. Contingencies are calculated on the basis of 8% of civil works and equipment. Total building costs of sewerage system and wastewater treatment plant, as well as contingencies, are estimated at 65.4 millions of EUR.
3. Project management costs, which are estimated at 5.715 millions of EUR.

Total investment costs are calculated on constant prices and they are in accordance with project's documentation (»Organisation, construction and maintenance of the sewerage system within the water protection zones in the Region of Istria«, 2000).

Operational costs have an important role in total costs of a wastewater system and they are related to the operation, maintenance and monitoring the wastewater treatment plants. They include:

- Operating costs of wastewater treatment plant (WWTP) which include:
  - Costs of employees,
    Costs of employees are calculated for wastewater treatment plant as product of equivalent inhabitants and unit price per equivalent inhabitants and for the sewerage system as product of pipelines length and unit price.
  - Costs of electric power consumption,
    Calculation of electricity costs are the product of price of electric power, number of working days in the year (365) and electricity consumption in kWh/d (which depends of number of equivalent inhabitants and is different for pump stations and for wastewater treatment plant)
  - Costs of sludge disposal,
    Sludge disposal is calculated as product of price for a cistern and number of cisterns (total quantity of sludge/quantity of sludge in 1 cistern).
  - Costs of chemicals
- Maintenance costs of wastewater treatment plant (WWTP)

  Maintenance costs for pump stations and plants are calculated as 1% of civil works and 1.5% of equipment.
- Depreciation costs,

  Depreciation costs are calculated in accordance with the Croatian laws. For depreciation of the construction of the investments a rate of 2.0% annually is used, while the equipment is depreciated at the rate of 7.5% annually.

All annual operating, maintenance and depreciation costs are estimated at 2.7 millions of EUR. Base for the operational costs is in the study (»Organization, construction and maintenance of the sewerage system within the water protection zones in the Region of Istria«, 2000), but all the calculations have been made by the authors. Regarding the total costs of a wastewater systems operation costs play an important role and they will be incurred in a regular basis along the service life. They may differ widely from size and load of the plant, topography and geographical situation of the site, characteristics of wastewater and the discharge norm, technologies and the selected treatment process, type of sludge treatment and way of disposal, energy supply and energy recycling, degree of automation, measurement and process control and organization of the plant and its management. Accordingly, specific cost calculations can only be worked out on the basis of detailed data from the wastewater plant, like in the case described below.

The project has the following sources of financing: Croatian waters, fee for development, grants from EU funds as non-debt sources of financing and possible sources like funds from public-private partnership. Amounts of financing project System of public sewerage and water protection in the Region of Istria are shown in the next table.

Table 1: Structure of sources of financing

No.	Sources of financing	Amount	Structure in %
I	Budget financing	0	0.00
1.1.	National budget	0	0.00
II	Debt financing	0	0.00
2.1.	Credits or loans	0	0.00
III	Non-debt financing	77,142,857	100.00
3.1.	User´s charges: fee for development	24,870,748	32.24
3.2.	Croatian waters	4,081,633	5.29
3.3.	Structural funds of European Union	42,300,000	54.83
3.4.	Public-private partnership	5,890,476	7.64
	TOTAL	77,142,857	100.00

Source: Author

There are two types of revenues in operating of the project: revenues from discharging and treatment of waste water, calculated on the base of potable water quantities for the next 30 years and revenues due to solidarity of the population of the Region of Istra.

The project has financial sustainability during the whole lifetime of the project. Financial sustainability is showing net cash flow – inflows should be higher than outflows.

Results of financial analysis are the financial internal rate of return and the financial net present value. The net present value is presented with the financial return on investment (capacity of operating revenues to sustain the investment and operational costs) and is calculated in the amount of –46,589,577 EUR. The financial internal rate of return is calculated as negative.

In the analysis all market prices are net of VAT and other indirect taxes. This correction is done because they represent neither a social benefit nor a cost. Taxes are paid by consumers to the project, from the project to the Tax Administration, and are then redistributed to the consumers as public expenditures. Prices of inputs, including labour, to be considered in the CBA should be gross of direct taxes and subsidies granted by a public entity to the project promoter are pure transfer payments.

Benefits assessment of investment in maintaining and improving water quality should be implemented in the following groups according to the appropriate methodology (European Commission, 2008; Bezak, Tedeschi & Radujković; 1999):

- Benefits that can be expressed in monetary value are divided into direct and indirect:
  - The benefits of investment realization will result in better quality of water bodies and with reduced investment in the drinking water supply system. Because of water pollution, it is necessary to leave the existing resources and build new ones in remote areas, deeper underground, with significantly higher costs. The calculation took into account the amount of 20.40 EUR/person/year. The benefit was calculated as product of inhabitants and value of the willingness to pay for a better quality of water bodies (ECOTECH Research & Consulting Limited, 2001). In 2011 the population of Istria was 208 440.
  - Benefits from lower health risk of the population. In the circumstances of partly or mostly polluted water, a part of the population will have an organized water supply, but the other part of the population will consume water without adequate preparation. In the long term period this means the increase of the rate of patients with diseases caused by contaminated water. During other activities like swimming, boating, fishing etc. the population will come into contact with contaminated water, too.
  - Improving water supply, sewerage, drainage and building the waste water treatment plants that pollute the natural recipient, bring benefits in the form of cost reduction for those who would otherwise suffer from diseases spread by water, their families, the public health system and society as a whole. For example, in some European countries, the cost of illness is around 93 EUR per household. Because the Croatian Institute for Public Health does not keep statistics on those who are suffering from the use of contaminated water, the calculation in the table of Economic analysis is used the amount of 93 EUR per household as a criterion for cost of illness (ECOTECH Research & Consulting Limited, 2001). It was considered that an average household has three members.
  - Benefit from the use of unpolluted water for irrigation of agricultural products. Assessment of benefit due to irrigation is based on data of Karleuša (2003) and the Ministry of Agriculture, Fisheries and Rural Development. Increase of agricultural products with irrigation is as follows: for vegetables 5000 kg/ha, for fruits 2000 kg/ha, for vineyards 5800 kg/ha and for crops 5000 kg/ha. They are adjusted with an inflation rate (according to the data of Eurostat from the 16th December, 2011) for 2004 – 2.1%, 2005 – 3.0%, 2006 – 3.3%, 2007 – 2.7%, 2008 – 5.8%, 2009 – 2.2%, 2010 – 1.1% (year 2010 is the third year in this irrigation analysis). Inflation rate for 2011 is estimated to 2.5%. For the further period inflation the rate of 1% is used. To make a comparison the result without

a system of irrigation is shown. The prices of products are data of the Ministry of Agriculture, Fisheries and Rural Development and they are approximately specified for vegetables 0.8 EUR/kg, for fruits and grapes 1.33 EUR/kg and for products from crops 0.33 EUR/kg.

- The benefit for lack of constructing need, use of private cesspits and consequently no sewerage transport to a wastewater treatment plant. The population connected to the sewerage system will save the costs of sludge disposal. The calculation was made with the amount of 348 EUR per household in accordance with the report »The benefits of compliance with the environmental acquis for the candidate countries, Final report« (ECOTECH Research & Consulting Limited, 2001). It was considered that an average household has three members.

- Benefits that can be expressed as a qualitative effect, and cannot be expressed in monetary units:
  - Preservation and improvement of the quality of space for human life, as in the case of water pollution when human settlements located near water lose their basic quality.
  - Prevention of flora and fauna destruction.
  - Maintenance of natural system which will have a positive effect on people, like better mental condition and richer intellectual activities.

  Benefits that cannot be expressed in monetary value are also called »intangible« benefits. Those benefits have been ignored in the cost-benefit analysis of the project. The reason is that these benefits cannot be assessed, and their detailed qualitative effects can be described in the Analysis of environmental impact.

In the CBA analysis all market prices of inputs and outputs are corrected with standard conversion factor. All the conversion factors for specific type of investment and operational costs are presented in Table 2.

Table 2: Standard conversion factors

Type of cost	CF	Notes
Standard conversion factor	0.96	SCF for Republic of Croatia
Skilled labour	1.00	the labour market is assumed to be competitive
Unskilled labour	0.60	shadow wage for non-competitive labour market
Land expropriation	1.25	100% land acquisition
Land acquisition	1.25	SCF local price which is 30% higher than prices paid for expropriation
Building constructions	0.66	40% construction materials, 5% skilled labour, 45% unskilled labour, 10% profit
Material	0.83	55% machinery, 45% construction material
Maintenance	0.71	80% (15% skilled, 65% unskilled labour), 20% materials
Construction materials	0.85	75% local materials, 15% import, 10% profit
Energy	0.96	SCF
Feasibility study, project documentation, studies	1.00	100% skilled labour
Administrative, financial and economic services	1.00	100% skilled labour
Elimination of treatment sludge	0.80	30%unskilled labour, 20% transport, 50% local services
Equipment, machinery, manufactured goods, carpentry	0.82	50% unskilled labour, 50% equipment
Intermediate service and goods	0.71	10% skilled and 60% unskilled labour, 30% manufactured goods

Source: Florio et al. (2008, p. 175).

All investment and operational costs are corrected with conversion factors and their calculation is given in the table of Economic analysis of the project.

For that purpose an economic analysis which includes all benefits and revenues as well as investment and operational costs, was made.

The European Commission recommends that 5% financial discount rate is used for public investment projects which are co-financed by EU funds and 5.5% for social discount rate for cohesion and IPA countries. The time horizon of water and environment project is 30 year period (European Commission, 2008). The net present value is calculated on the base of 5.5% social discount factor.

All before mentioned costs and benefits and their net present values are calculated in Table 3. The calculation was made through a period of 30 years which is usual for capital infrastructure projects like »The System of Public Sewerage and Water Protection in the Region of Istria«.

In the case of calculation of the benefit of water bodies improvement (which have reduced investment in the drinking water supply system), for the first and second year there are no benefits because the project is in the preparation

phase and partly in building phase. From the third to seventh year benefit is calculated for the population in the area where wastewater treatment plants are built. With putting into operation all built plants, the benefit was calculated on the base that affects the entire population of Istria and this is shown in the next table for the 30 year period.

Based on the planned investments and the calculation of benefits and their net present values, a net profit of the project is derived, and it is shown in Table 3.

Table 3: Economic analysis

No.	Economic period	CF	Present value	Total amount
I.	BENEFITS			
1.	Improvement of water bodies Number of inhabitants Cost per person per year	1	50,711,278	114,268,042
2.	Benefit due to lower health risk Number of households connected Cost per household per year	1	4,393,550	11,088,809
3.	Benefits due to irrigation	1	1,910,499	4,949,951
4.	Benefits due to cost saving from sewerage disposal Number of households connected Cost per household per year	1	16,440,381	41,493,606
5.	REVENUES from discharging and treatment of waste water	1	6,207,661	15,667,413
6.	Revenues due to solidarity	1	26,291,871	63,881,689
	TOTAL BENEFITS		105,955,240	251,349,510
II.	COSTS			
1.	PROJECT DEVELOPMENT COSTS		5,946,314	6,861,429
1.1.	Project documentation	1.00		
1.2.	Geodesic works	1.00		
1.3.	Land acquisition	1.25		
2.	BUILDING COSTS		35,463,250	48,420,625
2.1.	Civil work and equipment	0.66/0.82		
3.	OPERATIONAL COSTS		20,076,240	50,810,384
4.	PROJECT MANAGEMENT COSTS	1.00	4,285,172	5,715,374
	TOTAL COSTS		65,770,976	111,807,811

Source: Petohleb Černeha, 2013

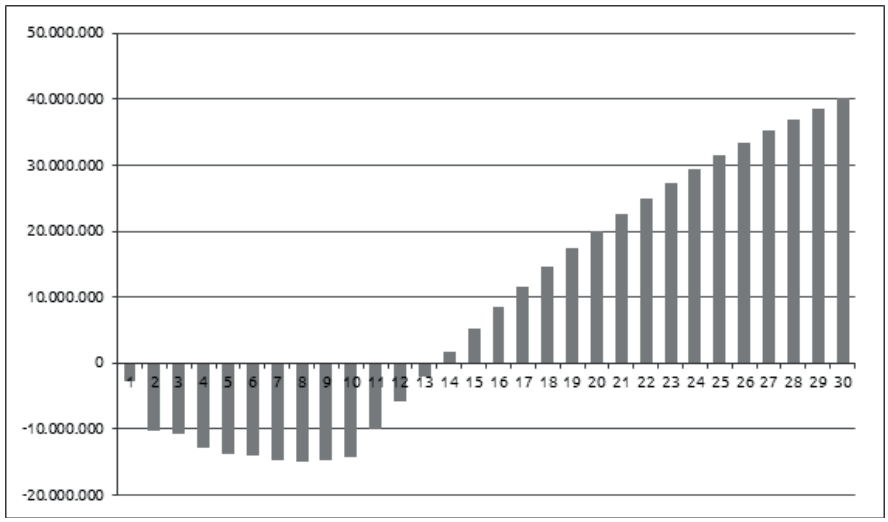
The present value of total benefits, costs and cumulated net cash flow during 30 year time period for the project are shown in Table 4.

Table 4: Net present value of cumulated net cash flow during 30 year period

Year	Present value of benefits	Present value of costs	Present value of cumulated net cash flow
1		2,642,937.74	–2,642,937.74
2		7,568,245.18	–10,211,182.92
3	4,057,936.92	4,469,943.25	–10,623,189.25
4	4,383,080.17	6,593,006.97	–12,833,116.05
5	4,378,296.15	5,298,657.49	–13,753,477.39
6	4,569,327.96	4,945,469.03	–14,129,618.46
7	4,520,282.26	5,037,039.77	–14,646,375.97
8	4,790,675.85	5,005,137.33	–14,860,837.44
9	4,789,688.20	4,577,360.84	–14,648,510.08
10	4,782,621.97	4,441,528.11	–14,307,416.22
11	5,518,217.09	1,204,954.64	–9,994,153.77
12	5,231,561.74	1,142,137.10	–5,904,729.13
13	4,959,806.82	1,082,594.41	–2,027,516.73
14	4,702,177.39	1,026,155.84	1,648,504.82
15	4,457,938.84	972,659.56	5,133,784.10
16	4,226,394.77	921,952.19	8,438,226.69
17	4,006,885.03	873,888.33	11,571,223.38
18	3,798,783.79	828,330.17	14,541,677.00
19	3,601,497.80	785,147.08	17,358,027.72
20	3,414,464.66	744,215.25	20,028,277.13
21	3,237,151.24	705,417.29	22,560,011.07
22	3,069,052.14	668,641.98	24,960,421.23
23	2,909,688.24	633,783.87	27,236,325.60
24	2,758,605.37	600,743.01	29,394,187.96
25	2,615,372.97	569,424.65	31,440,136.28
26	2,479,582.87	539,739.01	33,379,980.14
27	2,350,848.14	511,600.95	35,219,227.32
28	2,228,801.98	484,929.81	36,963,099.49
29	2,113,096.67	459,649.11	38,616,547.05
30	2,003,402.57	435,686.36	40,184,263.26

Source: Petohleb Černeha, 2013

Graph 1: Net present value of cumulated net cash flow during 30 year period



Source: Table 4

From the analysis the economic net present value in amount of 40,184,263 EUR and the economic internal rate of return which is 15.27%, were calculated. With such results the project is acceptable because when net present value is higher than zero and the higher is internal rate of return, is the more possible the realization of the project.

The economic assessment of the project includes the economic assessment at the project level and the economic evaluation from the viewpoint of society (social evaluation of profitability), which reflects the difference between benefits and costs from the viewpoint of economic entity and society (Bendeković,2008). The economic assessment of the project »The System of Public Sewerage and Water Protection in the Region of Istria« shows that the present value of net cash flow during 30 year period is positive because the present values of all the above mentioned benefits are higher than the present value of investment and operational costs. With those results the aim of CBA is achieved.

5 Conclusions

In this paper some theoretical issues about cost benefit analysis as estimation methodology for social profitability of infrastructure projects are discussed. The aim of cost-benefit analysis is to maximize net present value of total benefits expressed in monetary value (benefits in better quality of water bodies and with reduced investment in the drinking water supply system, benefits from lower health risk of the population, benefits from the use of unpolluted water for irrigation of agricultural products and benefits for lack of constructing need, use of private cesspits and consequently no sewerage

transport to a wastewater treatment plant.) minus total costs (investment and operational). In order to enter in the realization of such an infrastructure project it is essential to analyze the social costs and benefits and considering the results of CBA make a decision about acceptance the project. The theory is researched empirically and is tested on the example of the case study »The System of Public Sewerage and Water Protection in the Region of Istria«.

The interpretation of the results about social profitability and economic assessment of infrastructure projects should take into account the criteria for evaluation of infrastructure project such as net present value and internal rate of return, as well as results of CBA (present value of benefits should be higher than present value of costs). At CBA, two scenarios were possible: first, if the economic net present value and economic internal rate of return is higher than zero, the entrance into realization of the project is possible and second if the economic net present value and economic internal rate of return is less than zero, the project is unacceptable. On that basis it was concluded that the project achieves the social profitability, net profit and achieves high economic internal rate of return (15.27%). The results also show that the economic net present value is higher than zero (40,184,263 EUR). Based on the obtained results it is possible to accept the decision to enter into the realization of the project.

The research has shown that the financial cash flow during the 30 year time period for the project »The System of Public Sewerage and Water Protection in the Region of Istria« is positive. In CBA benefits can be realized with the project during the whole 30 year period, but they don't have direct influence on financial inflows of investors. That is the specific determinant of public sector and because of that the financing public infrastructure projects from EU funds are justified. The research in this article led to the results which can be used in public investments, especially in financing capital infrastructure projects by evaluating investments on basis of CBA results and in proving social profitability of projects through social benefits of the project, especially through expressing indirect benefits in monetary value which was the limitation in this research. The contribution of this research is in an acceptable developed economic assessment methodology with quantified benefits in monetary value which will offer investors an opportunity for financing public investments in many fields in Croatia or other countries.

Samanta Petohleb Černeha, dr. sc., is financial and accounting manager at IVS – Istrian water-protection system, ltd., Buzet, Croatia. Her main research fields are investment projects and cost - benefit analysis in public sector.

Maja Klun, Ph.D., is associate professor at Faculty of Administration. Her main research fields are taxation, performance budgeting and performance measurement in public sector.

Srečko Devjak, Ph.D., is a Full Professor at the Faculty of Administration for the field of quantitative analyses for administration support.

References

- Anandarup, R. (1990). *Cost-benefit Analysis: Issues and Methodologies*. London: The Johns Hopkins University Press for the World Bank.
- Bendeković, J. (2008). Analiza i struktura investicijskih projekata. *Računovodstvo, revizija i financije, 18*(4), 76–82.
- Bezak, S., Tedeschi, S., & Radujković, M. (1999). Optimizacija projekata zaštite okoliša kroz studiju troškova i koristi. *2. Hrvatska konferencija o vodama, Hrvatske vode od Jadrana do Dunava. Zbornik radova*. Dubrovnik: MTG Topgraf.
- Dinwiddy, C., & Teal, F. (1996). *Principles of cost-benefit analysis for developing countries*. Cambridge, UK: Cambridge University Press.
- ECOTECH Research & Consulting Limited. (2001). *The benefits of compliance with the environmental acquis for the candidate countries*. Final report.
- European Commission. (2009). *Regional Policy, Inforegio, Evalsed: the resource for the evaluation of socio-economic development*. Sourcebooks: Method and techniques. Retrieved 11. 6. 2011, from http://ec.europa.eu/regional_policy/sources/docgener/evaluation/evalsed/guide/methods_techniques/techniques_en.htm
- Europen Union. (2008). *Guide to Cost-Benefit Analysis of Investment Projects*. Luxembourg: Office for Official Publicatons of the Eurpean Communities.
- Florio, M., et al. (2007). *Vodič za analizu troškova i koristi investicijskih projekata*. Zagreb: Foip.
- Horvat, L. (1986). *Financiranje upravne djelatnosti*. Zagreb: Narodne novine.
- Layard, R., & Glaister, S. (1994). *Cost-Benefit Analysis*. Cambridge: Cambridge University Press.
- Mokrian, P. (2009). *Modeling and assessment of electricity market: iniciatives*. Stanford: Stanford University.
- Petohleb Černeha, S. (2013). *Optimization of Investment Financing In Local Governments* (doctoral dissertation). Ljubljana: Fakulteta za upravo.
- Teh – projekt hidro d.o.o. (2000). *Organization, construction and maintenance of the sewerage system within the water protection zones in the Region of Istria*. Rijeka.

POVZETEK

ANALIZA DRUŽBENIH STROŠKOV IN KORISTI KOT METODOLOGIJA VREDNOTENJA: ŠTUDIJA PRIMERA ZA INFRASTRUKTURNE PROJEKTE

Ključne besede: analiza stroškov in koristi, lokalne javne investicije, družbena vrednost projekta

Gospodarske investicije so pomemben dejavnik vsakega mesta, občine in države. V tranzicijskih državah in tudi v razvitih državah so zaradi hitre decentralizacije javnih funkcij lokalne oblasti pogosto v nezavidljivem finančnem položaju. Soočene so z nezadostnim proračunom, kar povzroča pomanjkanje finančnih sredstev za financiranje velikih infrastrukturnih projektov. Ker so investicije v infrastrukturne projekte kompleksne in drage, jih ni mogoče financirati iz proračuna lokalne oblasti. Glede na to, da decentralizacija vodi do zmanjšanja državnih finančnih sredstev, pa iz proračuna kapitalskih investicij na lokalni ravni ni mogoče financirati. Kadar proračunska sredstva lokalnih javnih organov ne zadostujejo in se želi zmanjšati zadolženost lokalnih oblasti za financiranje kompleksnih in dragih projektov lokalne in regionalne infrastrukture, se kot partner uveljavlja zasebni sektor. Tehnike združevanja sredstev lokalnega sektorja in zasebnega kapitala se uporabljajo za financiranje tistih projektov, ki imajo zadovoljivo stopnjo donosa na investirana sredstva in za katere obstaja visoka stopnja tveganja na donos kapitala.

Za ocenjevanje in izbor investicijskih projektov je najbolj objektivna osnova metoda diskontiranih denarnih tokov, ki upošteva velikost in časovne meje za pretok denarja v vsakem obdobju trajanja projekta. Za oceno upravičenosti investicijskih projektov je treba zagotoviti kapital za njihovo financiranje. Zato je treba najti dodatne vire financiranja v obliki kreditov in posojil, z izdajo komunalnih obveznic, z zaračunavanjem taks in združevanjem kapitala lokalnega javnega sektorja ter zasebnih podjetij (nedolžniško financiranje) in optimizirati stroške financiranja projekta. V prispevku je prikazana teoretična raziskava sodobnih modelov nedolžniškega financiranja lokalnih investicij, s primerom konkretne uporabe v lokalni samoupravi Republike Hrvaške. Nameni in cilji raziskave so bili: raziskati in analizirati vse bistvene značilnosti financiranja lokalnih javnih investicij (proračunskih, dolžniških in nedolžniških virov financiranja), analizirati prednosti in slabosti tradicionalnega financiranja projektov lokalne infrastrukture in javno zasebnega partnerstva pri financiranju lokalnih javnih investicij. Opravljena je bila ocena družbene donosnosti projekta (analiza stroškov in koristi) na primeru iz prakse, ki je temelj za začetek izvajanja projekta. V raziskavi so bile uporabljene statistične in matematične metode. Na primeru »Projekt odpadnih voda Istra« je izvedena analiza družbenih stroškov in koristi, in sicer z uporabo matematične metode za povečanje sedanje vrednosti socialnih prejemkov, zmanjšane za stroške. Zniževanje stroškov financiranja se je opravilo z metodo

linearnega programiranja, oziroma s standardno metodo simpleksov. Vsak problem linearnega programiranja ima tri kvantitativne komponente: merilo (v tej raziskavi je uporabljena obrestna mera) in cilj (optimizacija v smislu zmanjševanja stroškov financiranja), alternativni postopki za dosego tega cilja in omejena sredstva, kot pogoji za doseganje tega cilja. Metoda simpleksov je iteraktiven proces, ki v več medsebojno povezanih korakih reši sistem linearnih enačb. Metoda simpleksov v linearnem programiranju je idealna za izvajanje z računalniškimi aplikacijami. Obstaja več računalniških aplikacij za reševanje linearnih problemov programiranja. Primer takšnih orodij je reševalec kot sestavni del preglednic Excel.

Optimizacijski model je bil razvit na projektu Sistema javne kanalizacije in varstva voda v Istrski regiji. Pri izračunu denarnega toka projekta so odlivi projekta višji od prilivov v nekaj letih: v drugem, četrtem, sedmem, osmem, devetem in desetem letu. Zato projekt potrebuje dolžniške vire financiranja ali zasebne partnerje, ki se bi pridružili javnem sektorju.

Model je bil preizkušen na rezultatih analize stroškov in koristi s pogoji za zmanjševanje stroškov in omejitev tveganj. Zagotoviti ustrezno količino finančnih virov v skladu z negativno razliko med prilivi in odlivi projekta je bil eden od najpomembnejših ciljev modela. Ekonometrični in optimizacijski model je bil razvit na rezultatih opazovanja merila analize stroškov in koristi s pogoji za zmanjševanje stroškov in tveganj omejitev. Rezultati raziskave se lahko uporabljajo pri financiranju javnih naložb, posebej pri:

1. financiranju kapitalskih infrastrukturnih projektov na področju:
   a) izbire naložb na podlagi rezultatov analize stroškov in koristi,
   b) iskanja virov financiranja za dokaz finančne vzdržnosti investicijskih projektov,
   c) dokazovanja družbene dobičkonosnosti projekta z upoštevanjem družbenih koristi projekta, predvsem izražanja posredne koristi v denarnih postavkah,
   d) izbire med dolžniškim virom financiranja in modelom javno - zasebnega partnerstva med fazo naložb in operativne faze na osnovi obrestnih mer, tveganj in drugih finančnih stroškov, s pomočjo linearnega programiranja;
2. optimizacijskih modelih na področju:
   a) linearnega programiranja s kriterialno funkcijo maksimiziranja neto koristi, dobička pod določenimi omejitvami in omejitvami negativnosti,
   b) linearnega programiranja z kriterialno funkcijo minimiziranja stroškov (proizvodnje, priprave, naložb, operativnih, finančnih) v okviru določenih omejitev in omejitev negativnosti.