

## THE PARTICULARITIES OF THE ANALYSIS OF COST – PROFIT IN THE RAILWAY SYSTEM IN ROMANIA

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### 1. Introduction

The analysis of cost-profit constitutes the instrument of evaluation of the advantages of the investments from the point of view of all the factors interested, based on the monetary values attributed to the positive and negative consequences of the projects. This is part of the feasibility study which includes: the identification of the investment and the defining of the objectives, the analysis of the options, the financial analysis, including the calculation of the indicators of financial performance (the amount accumulated, the actual net value, the internal rate of profitability, and the rapport cost-profit); the economical analysis (for major public investments)<sup>1</sup>.

The particularities of analysis of cost-profit can be pointed out through the example of rehabilitation and modernization of the railway line Craiova – Calafat, part of the 4<sup>th</sup> Railway Corridor Pan-European, which has a great importance for the Romanian economy. This line crosses the south-west of the Romanian Plain, from Craiova, the line is directed towards south-west, crossing the Bailești Plain, the Danube Waterside and gets to the Calafat Harbor and the Point of crossing the border Calafat – Vidin. The railway line Craiova – Calafat, 107

km long, is simple, in-electrified and it was built in 1890, being used from 1895.

### 2.1 The investment into the railway field – necessity and objectives

In the domain of the administration of the railway infrastructure, the investments have, as a characteristic, an important financial effort, and the financial results appear only after the project is finished, after a long period of time. The necessity of finishing these is imposed by the nowadays situation of the railway infrastructure, being in a continuous degradation thanks to the insufficiency of funds assigned for the repairs. It is the case of the Craiova – Calafat railway line which is in a condition of depreciation which endangers the safety of circulation, being many restrictions of speed and dangerous points thanks to the instabilities and defections that appeared in the last years. To maintain some acceptable condition of safety, in exploration, some major speed restrictions have been imposed, which have brought an addition loss of time. The reducing of speed for the passenger and goods trains, due to the precarious conditions of the infrastructure and the railway installations, determines inflexibility into the schedule of traffic compared to other means of transport, the decrease of number of trains per day and, in general, a lower quality of services (delays). So, I consider that the insufficient level in quality of the offer of services is determined by:

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<sup>1</sup> \*\*\*The decision of the Romanian Government no. 8 regarding the approval of content – part of the technical – economic documentation afferent to the public investments as well as the structure and methodology of elaborating the general list for the objectives of investments and the objectives of intervention published on the Official Monitor no. 48 on January, the 22<sup>nd</sup> 2008.

→ the reducing of the commercial speed, both in the passenger traffic and in the goods one;

→ a schedule of traffic that doesn't have the necessary flexibility to compete with other means of transport;

→ the scale of services offered in trains during the journey has no corresponding level;

→ the lack of certain civilized conditions in certain railway stations: ancient platforms with no sewerage system to evacuate the water, insanitary waiting rooms with no endowments: incomplete information, the selling of tickets through old technology, inadequate systems of alimentation with drinkable water.

Under these conditions, the general objectives for investments are:

➤ the rehabilitation and modernisation of the railway infrastructure;

➤ the improvement in traffic conditions;

➤ the insurance and the sustainability of the mobility;

➤ the stimulation of the economical and industrial growth;

➤ the development of adjacent areas and regions.

## **2.2 Decisional alternatives and afferent costs**

For the elaboration of the feasibility study, three alternatives to rehabilitate the Craiova – Calafat line have been taken into consideration. The first one takes into consideration some little works of improvement, and alternatives 2 and 3 imply major improvements for the infrastructure.

For the investments made in the railway domain, the costs have the following components:

➤ expenses to acquire the land and to organize – these include expenses for the arrangement destined to protect the environment;

➤ expenses for the technical assistance and the projection, including the topography, consulting, the auction and the technical assistance during the workings.

➤ expenses for the basic workings, both civil and technological, including the assembling of the technological installations and equipments.

➤ other expenses – consisting in the organising of the works, the commissions, taxes and other management expenses.

➤ expenses to put them in function, consisting in technological tests, try outs and the training of the personnel.

Among these, the greatest weight has the expenses made for the basic workings (fig. no. 1), which include the costs for the working on the embankment (dams, protection workings) structures (bridges, passages and tunnels); supra-structure; technologies (signalising, telecommunications, alimentering with energy and contact line); constructions and installations (including the electrical ones, sanitary and thermo-technological); machines and equipments. The supra-structure and the workings on the embankment are the main articles of cost of the workings, all together represent over 60% from all the expenses, but the technologies represent an important article of costs, almost 20%.

In table no. 1, it is presented the total cost of the investments of the three alternatives of rehabilitation and modernisation, divided into five chapters of costs mentioned:

**Table no. 1 The total cost for the investments into the Craiova – Calafat line**  
-thousand lei-

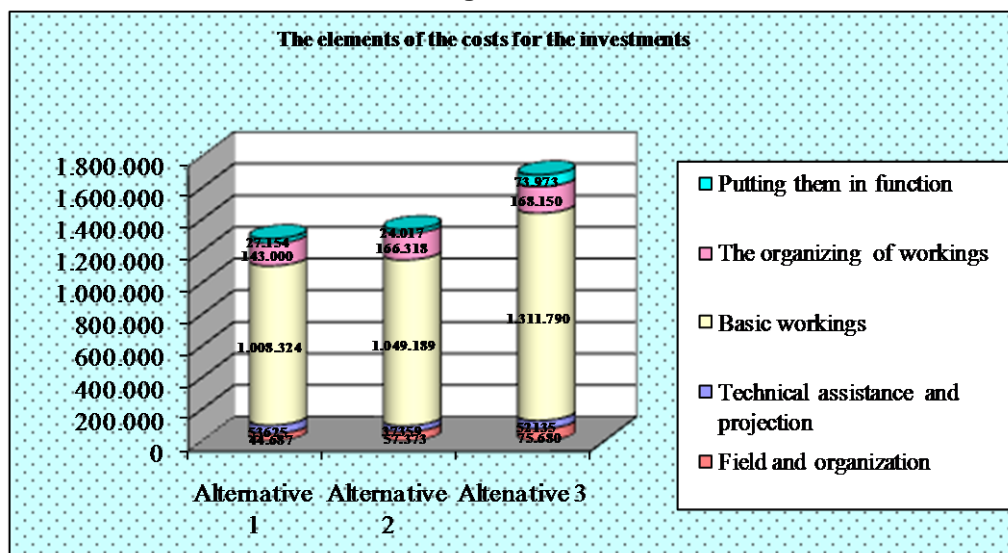
Nr. crt	Name	Alternative 1	Alternative 2	Alternative 3
1	Field and organization	44.687	57.373	75.680
2	Technical assistance and projection	53.625	37.359	52.135
3	Basic workings	1.008.324	1.049.189	1.311.790
4	The organizing of workings	143.000	166.318	168.150
5	Putting them in function	27.154	24.017	73.973
<b>6</b>	<b>Total cost (without TVA)</b>	<b>1.276.790</b>	<b>1.334.256</b>	<b>1.681.728</b>

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From the data presented in the table we can establish that the second version represents an intermediary solution, which includes a higher volume of workings of rehabilitation, as compared to the first alternative, this is why its cost is higher than the one of the first alternative, but considerably lower than the cost of the third alternative. The most significant weight is held by the costs for the basic workings, in all the three alternatives of the project (78,97%, 78,63% and 78,00%). Then the cost for

the organization of the workings, which weight 11,20%, 12,47 and 10,00%. The total costs for the investments due to alternative 2 are 4,5% higher than those of the alternative 1, whereas to accomplish alternative 3, which is a more performing solution technically speaking, it is necessary a total investment which is 31,7% higher than the cost of the first alternative. The differences appear, generally, due to the new structure that will be built (tunnels and bridges).

**Figure no. 1**



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I consider that, the estimation for the costs of the basic workings is an essential part of total cost of the

investment. They are related in detail in the following table.

Table no. 2 The total cost for the basic workings to the Craiova – Calafat line

-thousand lei-

Nrcrt	Name	Alternative 1	Alternative 2	Alternative 3
1	Embankment workings	421.479	426.237	446.537
2	Structures	52.433	46.276	302.418
2.1	- bridges	28.015	32.636	76.425
2.2	- footbridges	24.418	13.640	17.053
2.3	- tunnels	0	0	208.940
3	Supra-structures	211.748	210.886	199.400
4	Technologies of signaling, telecommunications	173.432	230.820	225.600
5	Buildings and installations (electric, sanitary)	149.232	134.970	137.835
6	<b>Total cost (without TVA)</b>	<b>1.008.324</b>	<b>1.049.189</b>	<b>1.311.790</b>

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From the data presented in the table, we can deduce that in the three alternatives of investment, the supra-structure and the embankment workings are the main articles of cost for the basic workings, reaching together over 62,90%, 60,73 and 49,24 from the total, and the technologies represent an important article of costs in a percentage of approximately 17,20%, 22,00% and 17,20%.

The investment costs for each alternative of the project and for each section of railway line were calculated

based on the technical studies. The economical price of the investment costs is the price presented without any taxes, subventions and other corrections. In the economical analysis, we use a general conversion factor of 0,847 to calculate the economic price of the investment, of the maintenance and the residual value, in accordance with the General Master-plan of Transportation. The year 2010 was considered as being the beginning moment of the project, and the first year of exploiting is 2015.

Table no. 3 The costs of the economic investment

-thousand lei-

Nr. crt.	Year	Alternative 1	Alternative 2	Alternative 3
1	2010	21.628	22.602	28.489
2	2011	86.515	90.408	113.953
3	2012	356.875	372.936	470.059
4	2013	400.137	418.144	527.037
5	2014	194.658	203.422	256.395
6	2015	21.629	22.602	28.489
7	<b>Total</b>	<b>1.081.442</b>	<b>1.130.114</b>	<b>1.424.422</b>

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In the results category, in accordance with the indications from the

General Master-plan of Transport for Romania – The Evaluation Guide and of

making the Projects from the Railway Sector (May 2008) a Priority, they have taken into consideration the following:

a) the results generated by the exploitation and the construction of the infrastructure:

- the residual value of investment;
- the economies of the costs to maintain the infrastructure;
- the economies of the costs for the exploitation of the infrastructure.

b) the results obtained from the existing railway transportation operations:

- the economies of costs for the exploitation of the fields;
- the economies of time for passengers and goods;
- externalities – the economies from the emission of the carbon dioxide.

c) the results generated by the avoidance of the deviation of the railway traffic towards the road one:

- the earnings obtained from the difference between the unitary costs of production in the railway and road domains;
- the external economies of costs:

- the costs of the accidents
- the costs of the polluting air;
- the costs for the climate changes (the emission of the carbon dioxide).

The results coming from the exploitation and construction of the infrastructure include:

#### ▣The residual value of the investment.

The evaluation of the residual value was made through an analytical approach being taken into consideration the long life of different components of the project, the period of analysis including the period of construction and a linear depreciation, in accordance with the Romanian legislation.

The residual value of each component (Table no. 5) was calculated starting from the medium value of intervals for the part of the technical long life which surpasses 25 years by taking into consideration a linear depreciation and the costs for each alternative of investment grouped on those components (Table no. 4)

**Table no. 4. The costs of the investment alternatives on groups of components**

- thousand lei -

Nr. crt	Name	Alternative 1	Alternative 2	Alternative 3
1	Bridges	28.015	32.636	76.425
2	Tunnels	0	0	208.940
3	Field acquisition	18.430	24.883	52.036
4	Substructures	262.133	289.738	297.100
5	Lines	191.754	191.189	184.949
6	Technical equipment	139.255	138.824	135.324
7	Alimentation with energy	108.016	107.616	105.682
8	Environmental installations	20.928	21.778	27.227
9	Buildings	149.232	134.970	137.835
10	Walls for support	144.184	154.216	165.531
11	Other costs	214.843	238.406	290.679
<b>12</b>	<b>Total costs</b>	<b>1.276.790</b>	<b>1.334.256</b>	<b>1.681.728</b>

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Table no. 5 The financial residual value after 25 years, on components

-thousand lei-

Nr crt	Name	Alternative 1	Alternative 2	Alternative 3
1	Bridges	12.450	14.505	33.967
2	Tunnels	0	0	104.470
3	Field acquisition	13.823	18.662	39.026
4	Substructures	131.065	144.869	148.552
5	Lines	71.908	71.697	69.356
6	Technical equipment	0	0	0
7	Alimentation with energy	0	0	0
8	Environmental installations	0	0	0
9	Buildings	59.988	59.988	61.259
10	Walls for support	0	0	0
11	<b>Total</b>	<b>289.233</b>	<b>309.721</b>	<b>456.630</b>

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The residual value obtained is converted to an economical price by using a factor equal to 0,847 resulting the following values: 244,980 thousand lei

and 386, 766 thousand lei. So, the total investment for all three possible alternatives is presented in the following table:

Table no. 6 The total investment

-mii lei-

Nr. crt	Name	Alternative 1	Alternative 2	Alternative 3
1	The costs for the investments	1.081.442	1.130.114	1.424.422
2	The residual value	244.980	262.334	386.766
3	<b>Total investment</b>	<b>836.462</b>	<b>867.780</b>	<b>1.037.656</b>

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✧ **The economies cost to maintain the infrastructure.** To continue exploiting the existing infrastructure, we must do some workings of extraordinary maintenance (renewal) and of routine, especially in the initial period, when the investments to remove the dangerous points and to recover the dept in maintenance (the process of maintaining a system into the exploitation position wanted or to bring it to that position; the existing goods are renewed, but not replaced, the workings consist in: inspections, measurements, service and repairs) are necessary. The renewal presumes all the activities implicated in the replacing of a part or

object in the railway infrastructure with a part or object of railway infrastructure identical or similar. It is financed when it is executed and then it is depreciated.

✧ **The economies of the costs of exploring the infrastructure.** The cost for the railway infrastructure, from the infrastructure point of view, is mainly connected to the activities in the stations (traffic control, ticketing, cleaning, etc.) and to the cost with the personnel, which is the most important part of that cost. The introduction of new technologies allows the reduction of the number of persons implicated in activities and the reducing of other costs.

**The results obtained from the operations of the existing railway transportation** include:

⊖ **The economies in the cost of the passengers and goods transport.** The new alternatives of the project of investment allow the reducing of the costs in the exploration of the fields. The exploration costs are based on the costs with the personnel, the maintenance of the equipment and the electrical consume.

⊖ **The economies cost during a journey.** The result obtained during a journey on the line was calculated for the existing passenger and goods traffic.

⊖ **The economies bound to the reducing of the carbon dioxide emissions.** Each alternative to this project, together with the relevant traffic and the railway exploiting way, which causes carbon dioxide emissions to the electrical power factory. It was used a model of simulation of the railway traffic which calculates the power consumption of trains based on the composition of the trains, the characteristics of the locomotives and the speed. According to the information published in Italy regarding the similar estimations to produce a kwh within a thermo-power station, we can obtain a emission of 0,58 kg of CO<sub>2</sub>.

**The results generated through the deviation of the road traffic towards the railway one.** These were estimated through: the calculation of the medium unitary cost per train – km and car – km; its multiplication with the length of the relevant route and with the traffic deviated from the railway road; the calculation of the total economies of cost for the deviant traffic.

**The external economies cost.** The external costs consists of medium costs (noise, air pollution, congestion, nature and landscape, earth and water pollution) the costs of accidents and the costs for the climate changes.

Evidently, this part of transportation costs is not evaluated on

the market. The consequence is that – the road and air travel being a higher consumer on the external than the railway one – the module competition doesn't take into consideration its effects, so, the travelling market is distorted and the use of the resources is not optimized. On the contrary, a typical economical analysis must take into consideration both the externals and the other costs. Generally, these effects are calculated due to the deviation of the traffic jam from one way to another (from the road to the railway one, as presented here). The changes in the means of transport can affect the persons exposed to the impact on the environment, even if they are not direct users of those means of transport. As it is known, the railway is, from the environment point of view, a means of transport more favorable; so, any deviation from the road transportation to the railway one will have as a result lower social costs on the traffic unit. The monetary values for the variables of the environment were the subject of a long debate as we must take into consideration three different aspects when we talk about the evaluation of the effects upon the environment:

- the present and future values of the damages upon the human health, the vegetation and the buildings;
- the prevention costs of such damages;
- the transmission values of an intact environment for the next generation

*The accidents cost.* The unitary value of the cost for the accidents for the railway sector is of 0,006 Euro/vehicle – km in 2008.

*The polluted air cost.* The basic unitary values have been estimated through adapting the recommendations of the General Plan of Transport which come from "The Estimation of the External Costs in the Transport Sector Book of the European Council".

For the three possible alternatives have been calculated the present net results, using a very new rate of 5,5%. Adding all these during 30

years, it results a present net value of 245.884,9 thousand lei, 228.389,8 thousand lei and 43.848,2 thousand lei. Taking these values we have calculated the profitableness index and the internal rate of profitableness.

Table no.7 presents the results the economic analysis of the three alternatives of the project of investment calculated for the Craiova – Calafat railway line.

**Table no. 7 The results of the economic analysis for the three alternatives**

Name	Unit of measure	Alternative 1	Alternative 2	Alternative 3
Index of profitableness		1,29	1,26	1,04
The internal profitableness rate	%	7.12	6.94	5.75
The up to date net value (5,5%)	thousand lei	245.884,9	228.389,8	43.848,2
<b>Hierarchy (RIR)</b>		<b>The first</b>	<b>The second</b>	<b>The third</b>
<b>Hierarchy (VAN)</b>		<b>The first</b>	<b>The second</b>	<b>The third</b>

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In conclusion, having an internal rate of profitableness bigger than the bringing up to date rate (5,5%), each alternative for the investment project can be accepted. With all these, using as a criteria of selection the net value presented as well as the internal value of profitableness we recommend the first alternative.

### 3. Conclusions

The necessary investments to modernize the railway infrastructure lead to an immobilization of capital and it will

be done during many years under some risks. Under these risks, the hope for obtaining a future profitableness is high. These have a contribution to the development of the railway transport, as a necessary condition to successfully implement other priorities of development of Romania in the future, contributing to the growth of the mobility of persons and goods, to the integration of the regional poles of growth into the trans-European transport network, to combat the isolation of area underdeveloped and, not at last, to the development of the regional and local railway infrastructure.

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