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New economic evaluation methodology development of industrial projects

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***Abstract*—This article presents the contributions on the development of economic evaluation methodology (step-by-step) of industrial projects (M.E.E.P.I.). Also, there were researched and grouped the economic indicators of investment efficiency in a system of indicators (model V.R.Q.R.R.T.), typical of industrial projects in Romania, that shows most clearly the efficiency of the project, including the methodology presentation of indicators calculation. Has been made and the chart of evaluation, comparison and selection of industrial projects in accordance with the methodology M.E.E.P.I.**

***Keywords*—M.E.E.P.I.; V.R.Q.R.R.T.; economic evaluation; investment efficiency; industrial projects;**

I. INTRODUCTION

Economic evaluation of projects is an essential operation essential for the activity of investment decisions. All project solutions adopted are accompanied by calculations and technical, economic and financial analysis, for projects implemented to always be the most effective of the following alternatives and capital allocation [1, 2]. Economic evaluation of investment projects refers to economic phenomena (including financial ones) and operates with economic notions, patterns, techniques and instruments, realizing the enormous correspondence between resources and requirements, such resource consumption will be justified only by getting significant results [3].

Economic evaluation of investment projects must provide clear, relevant answers to a large number of questions, issues and concerns of investors [1, 3, and 4]. Of these, the most important are presented in table I:

TABLE I. QUESTIONS FOR THE ECONOMIC EVALUATION

What follows the investor through the initiation of this project?
Project solutions adopted or planned achieve the goals formulated.
What constraints exist in the choice of possible solutions identified?
What is the model of efficiency criteria and indicators that will be used to assess the effectiveness of possible solutions and how depends on the level of investment efficiency variables and parameters of possible solutions features project?
Which solutions and variants ensure the efficiency of allocated capital, analyzing the indicators and efficiency criteria, and therefore should be chosen?
How many and which of the projects analyzed must be accepted within the limits of the budget?

Economic evaluation of investment projects involves, first, rigorous estimate of the investment efforts and their correlation with income and expenditure flows. Below is presented the economic evaluation methodology of industrial projects, called the continued (***M.E.E.P.I***.), with all the steps and sub steps of this. The considered objectives of ***M.E.E.P.I.*** are [3]:

TABLE II. M.E.E.P.I. OBJECTIVES

The argumentation of the utility and viability of investment project, in terms of sectoral and macro-social interests.
Verification and certification of the opportunity and the viability of the project, by on direct and indirect interests positions of the entities participating in its implementation: financing institutions, shareholders, investors, beneficiaries.
Investment decision, which maximizes the market value of the project.

II. M.E.E.P.I. STEPS

M.E.E.P.I. 1 - Step of planning and selection of the investment initial elements

The purpose of this step is the identification, evaluation and quantification of the financial elements of a project investment [5].

M.E.E.P.I. 1.1 - Setting the size of the project initial investment, I_j. The project initial investment I_j is represented by the value (size) of the capital required for the realizing of project.

$$I_j = I_1(1+k)^{d-1} + I_2(1+k)^{d-2} + ... + I_h(1+k) + I_{h+1}, \quad (1)$$

where:

d - The maximum duration of realizing the project, years;

I_1 - The first trance of investments, corresponding to construction first year;

I_h - The trance investment corresponding of year h;

I_{h+1} - The last trance of investments, corresponding to construction last year;

M.E.E.P.I. 1.2 - Setting the discount rate, *k*

If the value of investment is from own sources, the discount rate is established on the basis of the average profitability of the funds invested in the period immediately prior to the project [6]. If financing is done from several external sources, the discount rate of must be brought to a weighted average size of different sources capital costs, adding a risk margin [3]:

$$k = k_1 + \chi, \tag{2}$$

where:

k - Interest rate applied by the lender including the margin of risk;

k_1 - Monetary market interest rate without risk of capital borrowed;

χ - Margin of risk (the amount of additional risk premium assumed through investments in certain industrial projects types, more or less risky);

M.E.E.P.I. 1.3 – Setting the available cash flows, CFD_h

To calculate the available cash flow in any year *h* of life project CFD_h, it starts from a profit and loss account of the investment, which also must be estimated as precisely (estimates for incomes and project future payments) [3, 7]:

$$PN_h = PB_h(1-16\%), \tag{3}$$

where:

PN_h - Net profit after tax;

PB_h - Gross profit from the project operation (estimate);

16% - Taxation of gross profit share;

$$CFD_h = PN_h + A_h - Ce_h, \tag{4}$$

where:

Ce_h - Economical growth formed of immobilizations variation on *h* year and net current assets variation from net debt;

A_h - Depreciation for the *h* year for the project new assets;

M.E.E.P.I. 1.4 Setting the life cycle of the project, *n*

For setting the project life duration are taken into account more concepts, as follows: technical duration of project, the accountant duration, the commercial duration and use the legal duration of the project. In practice the four durations will not ever be equal. That's why in the calculations for determining the efficiency of industrial projects, will be used the duration considered representative for the projects examined [3, 8, and 9]. In fact, in the current economic crisis the estimate preview periods bigger than 5-7 years, does not lead to reliable results for investors. For longer projects may equivalence the future cash flows with residual values equivalent to the times *h=5-7*.

M.E.E.P.I. 1.5 Setting of project residual value, VR_n

Residual value is the amount that can be recovered in fixed assets taken out of operation at the end of their normal life cycle (*n*) [10]. In fact, the residual value can be determined according to the equation 5:

$$VR_n = \frac{CFD_{n+1}}{(k-f)}, \tag{5}$$

where:

CFD_{n+1} - Cash flow from the next year following the expiration of the reference period (*n*);

k - The discount rate of project, $k > f$;

f - The average annual growth rate estimate for the project cash flow;

M.E.E.P.I. 2 – Step of economic evaluation according to the model *V.R.Q.R.R.T. [3]*

In industrial projects, implemented in our country of the beneficiary's own project funds or bank loans, it proposes the following economic evaluation model consists of the following indicators (V.R.Q.R.R.T.), outlined below. Were chose these indicators in the model because they reflect the best economic efficiency of industrial projects and quantify the main worry of investors in the current economic crisis.

The **V.R.Q.R.R.T** model is composed of:

- Net updated value, *VAN(k%)* ;
- Static and dynamic economic performance, *RE, RE'*;
- Ratio between income/ expense total updated, *Q*;
- Internal rate of return, *RIR*;
- Internal rate of return modified, *RIRM*;
- Duration of capital recovery static and dynamic, TR_{static} , $TR_{dinamic}$;

$$VAN(k\%) = \sum_{h=1}^{n}(PN_h + A_h - Ce_h)(1+k)^{-h} =$$

$$= \sum_{h=1}^{n}(CF_{functionare} - Ce_h)(1+k)^{-h} = \tag{6}$$

$$= \sum_{h=1}^{n} CFD_h(1+k)^{-h}.$$

If the static economic performance is express depending on the life duration of the project, [7]:

$$RE = \frac{P_t}{I_j} - 1 = \frac{P_{h(mediu)} \cdot n}{P_{h(mediu)} \cdot TR} - 1 = \frac{n}{TR} - 1. \tag{7}$$

where:

P_t - Total profit;

$P_{h(mediu)}$ - Average value of profit;

For the calculation of dynamic economic performance, *RE'* it will use the updated values of profit and the initial investment:

$$RE' = \frac{VA(P_t)}{VA(I_j)} = \frac{\sum_{h=1}^{n} P_h \cdot (1+k)^{-h}}{\sum_{h=1}^{n} I_h (1+k)^{-h}}. \quad (8)$$

The ratio between the incomes and the total expenditures updated, *Q* is used as a ranking criterion of investment projects, because every investor or the beneficiary of the project wants to maximize revenue per cost unit [8].

$$Q = \frac{\sum_{h=1}^{n} V_h (1+k)^{-h}}{\sum_{h=1}^{n} (I_h + CE_h)(1+k)^{-h}}. \quad (9)$$

The *RIR* level shall be determined by successive attempts, because it is not a relationship of direct calculation. Thus, it will be calculated *VAN* at different discount rates *k* and almost close rate will reach *k*, for which *VAN(k%)=0*.

$$RIR = k_{\min} + (k_{\max} - k_{\min}) \cdot \frac{VAN(k_{\min})}{VAN(k_{\min}) - VAN(k_{\max})}, \quad (10)$$

where:

$k_{\min}$ - The lowest discount rate for that: $VAN(k_{\min}) > 0$;

$k_{\max}$ - The highest discount rate for that: $VAN(k_{\max}) < 0$;

The internal rate of return modified *RIRM* represents a function $f(k)$ of the discount rate *k*, for which the future capitalized values of the initial investment and the cash flows becomes equal at the end of the project life cycle [3, 4, 7]:

$$RIRM = f(k) = \left[\left(\frac{\sum_{h=1}^{n} CFD_h (1+k)^{n-h} + VR_n}{VA(I_j)} \right)^{\frac{1}{n}} - 1 \right] \cdot 100 \quad (11)$$

Both in theoretical considerations, but also in practice the duration of capital recovery is calculated in static and dynamic approach to the investment process and it is express in years. In fact, the duration of investment recovery is the ratio between the value of the initial investment and an annual volume of benefits considered [2, 3].

$$TR_{static} = \frac{I_j}{\frac{\sum_{h=1}^{n} (PN_h + A_h - Ce_h)}{n}} = \frac{n \cdot I_j}{\sum_{h=1}^{n} (PN_h + A_h - Ce_h)}, \quad (12)$$

$$TR_{dinamic} = \frac{n \cdot I_j}{\sum_{h=1}^{n} CFD_h (1+k)^{-h}}. \quad (13)$$

M.E.E.P.I. 3 – Step of project sensitivity analysis

For a more accurate estimate of the economic efficiency of an industrial project, it is necessary to assess the effect of changing the initial investment element values in the input model on the efficiency indicator (*VAN, RIR, Q, RIRM* etc). This is accomplished in a sensitivity analysis [3, 12].

By **M.E.E.P.I. 3** it follows:

The sensitivity analysis of the project indicators to some variations of parameters;
Determination the critical profitability of the project in terms of parameters variations;
Apparition probabilities of favorable or adverse events;
Determination of the external project risks (systemic risks, market risks, etc.);
Identification of critical variables that significantly influence the results of the project;
Effects of selected items variations (costs and benefits) on *VAN, RIR, Q*;

Thus, in industrial projects is tested the indicators stability at the costs and incomes variations (5-10%) of the entire estimate period [3]:

STEP 1: The initial investment amount and operating expenses are calculated increasing with 5% and 10%, and the annual revenues value and decreasing with 5%.

$$I_j^{'} = I_j + 5\% \cdot I_j, \quad (14)$$

$$\sum_{h=1}^{n} CE_h^{'} = \sum_{h=1}^{n} CE_h + 10\% \cdot \sum_{h=1}^{n} CE_h, \quad (15)$$

$$\sum_{h=1}^{n} V_h^{'} = \sum_{h=1}^{n} V_h - 5\% \cdot \sum_{h=1}^{n} V_h, \quad (16)$$

where:

$I_j^{'}$ - Initial investment value corresponding to M.E.E.P.I 3;

$\sum_{h=1}^{n} CE_h^{'}$ - Operating expenses value corresponding to M.E.E.P.I 3;

$\sum_{h=1}^{n} V_h^{'}$ - Annual revenues value corresponding to M.E.E.P.I. 3;

STEP 2: It is calculated the gross and net profit of the project;

$$\sum_{h=1}^{n} PB_h^{'} = \sum_{h=1}^{n} V_h^{'} - \sum_{h=1}^{n} CE_h^{'}. \quad (17)$$

STEP 3: The six indicators are calculated according to **M.E.E.P.I. 2** and will result the model *V'.R'.Q'.R'.R'.T'*

which must meet the minimum conditions required of indicators and *V'.R'.Q'.R'.R'.T'* not to be much smaller than *V.R.Q.R.R.T.* In **M.E.E.P.I. 3** calculation is not recommend to consider the advantageous variants than the average estimate.

M.E.E.P.I. 4 - The performance audit of the investment project

According to the I.N.T.O.S.A.I. standards (International Organization of Supreme Audit Institutions) the *performance audit* is defined as an economy, efficiency and effectiveness audit with which the audited company use resources in order to accomplish the objectives and responsibilities of the project. Performance audit is synonymous with the expression "value for money". Unlike the financial audit, performance audit is much broader and open to interpretations, expanding on the large periods of time. There is not only a financial exercise with certain documents, audit reports being very extensive containing comments and solutions to problems encountered by managers [11, 12]. The performance audit covers the following aspects [3, 13, and 14]:

- *Economical audit* – on the activities of the administrative management in accordance with the principles, practices and policies of an appropriate management.
- *Efficiency audit* – on the use of human resources, financial or any other kind, quantifying the risks that can occur and results (its objectives may cover the time you will realize the project, product, delays and causes generating estimates of the costs/results).
- *Effectiveness of audit results* – on the objectives pursued and the estimated impact of their activities in relation to the desired impact.

III. M.E.E.P.I. CHART

For each of the four stages of economic evaluation of the industrial projects, was presented the steps that must follow for their application, the data and information required, the tools and methods for management as well as the types of decisions to be taken by the company management [3].

Methodological proposal may be in a systematic and integrated method of management of industrial investments, to answer the criteria of economic and financial efficiency of the entire investment activities of an entity. Thus, the application can be connected to the four stages, as well as the accumulation of important experiences for managers and evaluators of projects, which can improve the methodology for assessing, reducing the implementation of investment projects ineffective risk, or with a high risk.

According to *V.R.Q.R.R.T.* model it considers that the dynamic approach is a t echnique better than the static approach as regards consideration of these indicators/criteria. Currently, the most used methods are those which require an analysis based on time factor influence on the profitability. In fact it is proposed the model of economic evaluation *V.R.Q.R.R.T.* achieved from six efficiency economic indicators.

According to the M.E.E.P.I. stages shown above will be made, an assessment scheme, comparison and selection of variants/industrial projects, represented in fig. 1 [3].

IV. CONCLUSIONS

The procedure for selection of investment projects is a problem features each organization, and the most important thing is the evaluation impact of enterprise-economic environment. Although there can not be quantified, this evaluation is used to determine the organization's development strategy. The selection of investment projects is carried out based on financial criteria, after establishing the initial elements of the investment and comparing them, but taking into account direct investment policy priorities. It refers to

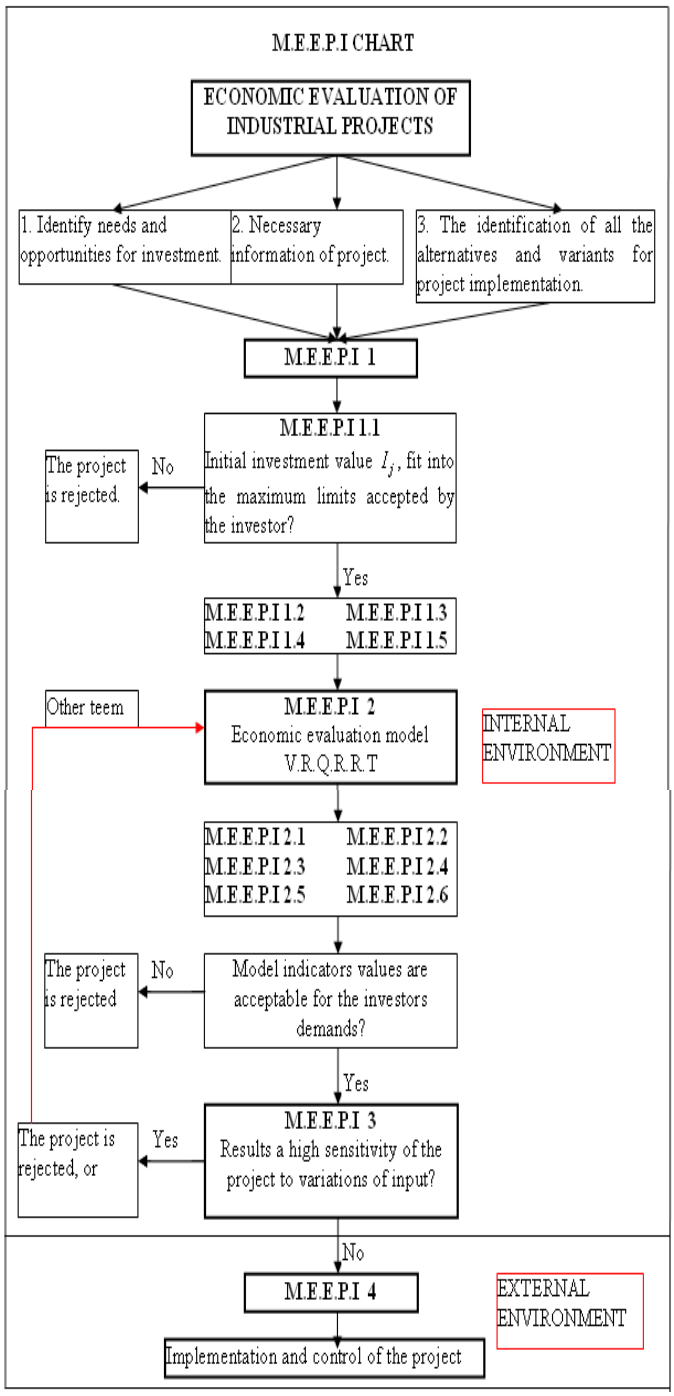

Fig. 1. Scheme of M.E.E.P.I.

choosing cost-effective investments depending on the resources that can be allocated to them. Investment decision is a decision of the general policy of the enterprise. It requires in enterprises an organization system that allows a good circulation of the information and ensures the coherence of decisions. The investment decision hires the enterprise over long periods and requires the establishment of funding policies in order to obtain the necessary funds. It is considered the allocation of available capital or collected.

Thus, this article provides important contributions to economic evaluation of projects by:

- Development of step-by-step methodology for evaluating solid economic industrial projects *M.E.E.P.I.*;

- Research and grouping of economic indicators in a system of indicators *V.R.Q.R.R.T.*, typical to industrial projects, which shows most clearly the effectiveness of the project; presentation of the methodology of calculation of the indicators, the comparison and selection of projects according to these.

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