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EVALUATION METHOD OF THE INNOVATION PROJECT GLOBAL EFFICIENCY

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Abstract: A complete system of indexes to evaluate the global efficiency of a new product development project must approach at least the following perspectives: the financial performances of the project; the project′s value; the technical performances of the project; the efficiency of research and development activities of the project; the capacity of fitting in the estimated cost and duration of activities; the degree of integration between the R&D and production activities; the degree of integration between the R&D and marketing activities. Therefore, in this paper is drawn up a method for new product development projects evaluation, based on those seven perspectives.
Keywords: innovation project; evaluation method; value; financial performances

1. Introduction

The financial evaluation of innovation project efficiency is a very useful tool for the manager's decisions referring to selecting and continuing a project. But only this criterion is not sufficient to take an optimum decision because a large majority of these projects are influenced by qualitative criteria.

Thus, the incomes flow generated by the project on its economic lifetime is mostly given by the project capacity to accomplish the main objectives like to achieve the settled technical performances and to maximize the degree of integration between research & development and production and marketing compartments. The project profitability depends on its capacity to offer new products or technologies in a short period of time.

The evaluation criteria used for the innovation projects are very diverse depending on some factors: the project's essential characteristics, the evaluation's goal, the moment when the evaluation takes place and the main features of the enterprise and of the industrial area of activity.

There were many attempts of configuring an evaluation criteria system that suit a large number of innovation projects. Certainly, the evaluation has to include both quantitative and qualitative criteria, and the number of criteria must be sufficiently great to allow an objective appreciation upon the project's viability.

Due to the fact that the evaluation process of the innovation projects is very dynamic, the nature and the importance of the evaluation criteria are very diverse depending on the stage of the project.

For a pertinent evaluation of an innovation project global efficiency it is very important to elaborate a complex system of indexes. That system must have an optimum number of indexes because a large number of indexes determine increased difficulties in the decision process.

Some of those indexes are based on a quantitative evaluation, but others imply a qualitative evaluation, so that, for a comprehensive evaluation of an innovation project, it must be assured the compatibility between all those indexes.

2. An indexes system for evaluation of innovation project global efficiency

An objective evaluation of global efficiency for an innovation project must be based on a complete system of indexes, consisting of indexes for the performance of the elaboration phase and also for performance of the running phase of the project. Also, it must be considered that the different stages activities of the project's economic lifetime contribute in different ways to the final project success. Thus, in the elaboration stage, the critical success factors depends on research & development activities while in the exploitation stage the performances mostly depends on integration degree between research & development activities and other activities of the enterprise.

In this context, a complete system of indexes for evaluating the global efficiency of an innovation project must approach at least the following perspectives:

- The financial performances of the project – reflects the capacity of future incomes to cover the investment and exploitation costs of the project;
- The project′s value;
- The technical performances of the project – influences the consumer's satisfaction degree and, consequently, the volume of the project future incomes;
- The efficiency of research and development activities of the project – determines the amount of cash outflows in the project elaboration stage;
- The capacity of fitting in the estimated cost and duration of activities – influences the amount of the project future incomes;
- The degree of integration between the research & development and production activities – determines the production cost level of the new products;
- The degree of integration between the research & development and marketing activities – influences the amount of the project future incomes.

The first two approaching perspectives offer a global vision about the project, referring to efficiency of all activities, starting with elaboration stage and finishing with the exploitation stage of the innovation project. The next three perspectives refer especially to the efficiency of the elaboration stage activities and the last two perspectives reflect the integration degree between research & development activities and other activities of the enterprise.

The evaluation of the financial performance of the project must consider at least the net present value, the modified internal rate of profitability and the term of recouping the investment.

The project′s value may be expressed by a performance index which is based on qualitative criteria of evaluation. The performance index is a useful tool that can be applied for innovation project's evaluation while other complex methods imply increased costs and longer project duration. A major advantage is that this index allows including both economic and extra-economic criteria. More than that, the performance index considers the different importance of the criteria depending on the nature of the project and specific conditions.

The technical performance index reflects the technical progress level, measured like difference between the current and the previous technical performances of a product, process or technology. If the project is technically a success, the current technical performances of the new product or process represents an improve comparing to the previous products or processes. This improvement is due to the innovation process.

The technical progress level of the innovation project can be compared with the competitor's technical performances, with the forecasted technical performances of the project, or with the technical performances of a similar previous project.

The technical performances of the innovation project can be expressed by the key technical parameters of the new product, process or technology. The technical performance objectives reflect, usually, the consumer's perception about the success of product technical performance level.

The technical performance level of an innovation project is given by the relation:

$$P_{th} = \frac{P^{e}{}_{th} - P^{i}{}_{th}}{P^{p}{}_{th} - P^{i}{}_{th}} \qquad (1)$$

where: P_{th} is the technical performance level of the innovation project;
$P^{e}{}_{th}$ is the effective (current) level of the innovation project technical performance;
$P^{i}{}_{th}$ is the initial (previous) level of the innovation project technical performance;
$P^{p}{}_{th}$ is the forecasted (planned) level of the innovation project technical performance.

The efficiency of research and development activities of the project measures the intensity of technical success obtained by the consumed resources (cost or time). It can be quantified with two indexes:

- the research & development productivity calculated based on the consummated resources cost ($P^{c}{}_{CD}$), with the relation:

$$p^{c}{}_{CD} = \frac{P_{th}}{C} \qquad (2)$$

where C is the consummated resources cost to obtain the required technical performances.

- the research & development productivity calculated based on the effective duration of activities ($P^{T}{}_{CD}$), with the relation:

$$p^{T}{}_{CD} = \frac{P_{th}}{T} \qquad (3)$$

in which T is the effective duration to obtain the required technical performances.

The plan accomplishing relieves if, at the evaluation moment, the effective amount of all activities cumulated cost is fitted in the estimated cost amount. In the same time, it is shown if the effective duration of activities is fitted in the estimated duration and are calculated the plus or minus deviations from the planned situation.

The capacity of fitting in the estimated cost and duration of activities will be expressed by two indexes:

- the cost index will show the difference between the current cost and the estimated cost of the developed activities, given by the relation:

$$\Delta C = C^{p} - C^{e} \tag{4}$$

where: ΔC is the deviation of effective cost from the estimated cost;
C^{p} is the estimated (planned) amount of cumulated cost for all activities;
C^{e} is the effective amount of cumulated cost for all activities.

- the time index will show the difference between the effective duration and the planned duration of the developed activities, calculated by the relation:

$$\Delta D = D^{p} - D^{e} \tag{5}$$

where: ΔC is the deviation of effective duration of activities from the estimated duration;
C^{p} is the estimated (planned) duration for all activities;
C^{e} is the effective duration for all activities.

The degree of integration between the research & development and production activities relieves the efficiency of information exchange between research & development department and production department. It can be expressed by indexes like: the time to market, the number of redesigns or the average time of redesigns.

The time to market index represents the total time needed for elaboration of a new product, service or technology from the initial project stage to the launch on the market.

The total duration is given by the sum of the duration of each stage, according with the relation:

$$d_e = d_c + d_{pr} + d_{s0} + d_l \tag{6}$$

in which: d_e is the total elaboration time of the new product, service or technology (time to market);
d_c represents the duration of concept elaboration;
d_{pr} is the projecting duration of the new product, service or technology;
d_{s0} represents the duration of zero series production;
d_l is the duration of the launch on the market of the new product, service or technology.

The redesigns number of the new product, service or technology denoted N_{rp} is another index of integration degree between the research & development and production activities.

A large number of redesigns relieve a low integration degree. Optimum situation is given by a small number of redesigns with a short time to market. This index is linked with another one, the medium duration of a redesign ($\overline{d}_{rp}$). If that duration is large, the time to market is longer than estimated duration and the innovation project takes too much time.

The last index of integration degree between the research & development and production activities is the design efficiency based on production cost of the new product, service or technology (C_p) and manufacturing and testing possibilities of the enterprise referring to the new product, service or technology.

The degree of integration between the research & development and marketing activities reflects the efficiency of relationship between those two departments and can be expressed with the following indexes:

- the contribution of the new product, service or technology to the turnover growth ($P_{\Delta CA}$), given by the relation:

$$P_{\Delta CA} = \frac{CA_p}{\Delta CA} \tag{7}$$

where: CA_p is the turnover obtained based on the new product, service or technology;
ΔCA is the growth of the enterprise's total turnover after the launch of the new product, service or technology;

- the relative contribution of the new product, service or technology to the turnover growth of the portfolio of products (P_{CAg}), calculated with the relation:

$$P_{CAg} = \frac{CA_p}{CA_g} \tag{8}$$

where: CA_p is the turnover obtained based on the new product, service or technology;
CA_g is the portfolio turnover after the launch of the new product, service or technology;

- the contribution of the new product, service or technology to the profit growth ($P_{\Delta P}$), given by the relation:

$$P_{\Delta P} = \frac{PE_p}{\Delta PE} \quad (9)$$

where: PE_p is the exploitation profit bring by the new product, service or technology;
ΔPE is the growth of the total exploitation profit after the launch of the new product, service or technology;

- the relative contribution of the new product, service or technology to the profit growth of the portfolio of products (P_{Pg}), calculated with the relation:

$$P_{Pg} = \frac{PE_p}{PE_g} \quad (10)$$

where: PE_p is the exploitation profit bring by the new product, service or technology;
PE_g is the portfolio exploitation profit after the launch of the new product, service or technology;

- the accomplish degree with the consumer's needs of the new product, service or technology is determined by product quality features.

Each of the presented indexes is an evaluation criterion of the innovation project global efficiency. The indexes number in the evaluation system can vary in each particular case. In certain situations can be introduced some specific indexes needed by the innovation project features. In another situations, if the concrete conditions and known data require, some indexes can be removed from the evaluation system.

3. The indexes aggregation with the utility method

For an innovation project global efficiency evaluation, the indexes can be aggregate in an efficiency analysis system that allows the evaluation of project performances during the all innovation process.

Most of presented indexes are calculated based on a quantitative evaluation and some of it implies a qualitative evaluation. In those conditions, for an aggregate evaluation of the innovation project global efficiency, it has to be assured the compatibility of all indexes.

The compatibility can be realized using the utility method, which was drawn up in 1944 by John v. Neumann and Oscar Morgenstern. That method is used for making decisions in uncertainty conditions based on the utility of the processes characterized in a mono-criteria system. Due that the method allows summing the utilities of the different characteristics of a decisional variant it can be used for a multi-criteria evaluation of the innovation projects. In the same time, the method can express the project value in a non dimensional value: the utility.

The premises of the utility method assume that the innovation projects evaluation is based on both quantitative and qualitative criteria and the decision makers are differently interested in the dimension of each evaluation and selection criteria.

That method allows an integrated approach of a number of selection criteria for different efficiency categories like: strategic criterion, marketing criterion, financial criterion, production criterion etc.). In the same time, the utility method sort the importance of each evaluation criterion based on the nature and the features of the project.

The method can be used both for different time periods evaluation of the project efficiency and for different variants efficiency evaluation of the project in the same time.

The valuation of all variants of the innovation project with utility method assumes that each variant, denoted V_i, have a specific utility, denoted U_i. The main aim of the method consists in sorting in decrease order of the variant's utilities and selecting the greater utility value variant. The utility of each variant is given by the relation:

$$U_i = \sum_{j=1}^{n} K_j \cdot U_{ij} \quad (11)$$

in which: $i = 1 \div m$, is the number of the project variants;
$j = 1 \div n$, is the number of the evaluation criteria for the project variants;
K_j is the relative importance of the j criterion, which express the relative contribution of the j criterion to the project's success compared with all the criteria;
U_{ij} is the utility of the i variant corresponding to the j criterion.

For the qualitative criteria, to sort the relative importance and the utility, the expressions of those criteria will be quantified with 1 to 10 scale points.

The quantification will be realized according with the optimization conditions. Thus, the qualitative criterion with the best score (greatest score for the criteria optimized by maximum and lowest score for the criteria optimized by minimum) will be assigned with 10 points. The qualitative criterion with the lowest score (lowest score for the criteria optimized by maximum and greatest score for the criteria optimized by minimum) will be assigned with 1 point. The other qualitative criteria will be assigned with intermediate values of the score accordingly with the quantification for each of it.

The relative importance of each criterion determines in a major way the optimum selection of the project's variant with the best potential of success. The relative importance dimension of each evaluation criterion is given by the square matrix $C_{n\ x\ n} = (a_{j1j2})$. This matrix contents both on the lines and the columns all the evaluation criteria denoted $C_1, C_2, \ldots, C_j, \ldots, C_n$. The criteria from the matrix lines will be denoted C_{j1} and the criteria from the matrix columns will be denoted C_{j2}.

To establish the dimension of the relative importance, the criteria will be compared successively one with the other, from the left to the right and will be accorded scores after the following rule:

- $a_{j1j2} = 1$ if the two compared criteria have the same relative contribution to the project's success;
- $a_{j1j2} = 2$ if the left compared criterion has a superior relative contribution to the project's success than the right compared criterion;
- $a_{j1j2} = 0$ in other situations.

The relative importance of the j criterion is the ratio between the sums of the score points for the j criterion from the matrix line and the sums of the score points for the all criteria from the matrix line, given by the following relation:

$$K_j = K_{j1} = \frac{\sum_{j1=1}^{n} a_{j1j2}}{\sum_{j1=1}^{n}\sum_{j2=1}^{n} a_{j1j2}} \qquad (12)$$

where: $j1, j2, j = 1 \div n;\ 0 \leq K_j \leq 1;\ \sum_{j=1}^{n} K_j = 1$

To determine the utility of the i project's variant accordingly with the j criterion, denoted U_{ij}, it must be considered that some of the evaluation criteria are optimized by minimum and others are optimized by maximum. Thus, for the criteria optimized by maximum, the relation of the utility of the i project's variant accordingly with the j criterion is given by:

$$U_{ij} = \frac{x_{ij} - x_{j\,min}}{x_{j\,max} - x_{j\,min}}; \quad j \rightarrow maximum \qquad (13)$$

where: x_{ij} is the dimension of the j criterion in the case of the i project's variant;
$x_{j\ min}$ is the minimum value of the j criterion that characterizes one variant from the all i project's variant;
$x_{j\ max}$ is the maximum value of the j criterion that characterizes one variant from the all i project's variant;

For the criteria optimized by minimum, the utility of the i project's variant accordingly with the j criterion is given by the relation:

$$U_{ij} = \frac{x_{j\,max} - x_{ij}}{x_{j\,max} - x_{j\,min}}; \quad j \rightarrow minimum \qquad (14)$$

Finally, based on the relation 11, will be determined the value of the each project's variant given by utilities and will be selected the variant with the greatest value of the U_i utility.

4. The advantages of the proposed evaluation method of the innovation project global efficiency

Although it has a large degree of subjectivity, both on the assigning the scores to the qualitative criteria and on the evaluating the relative importance of the criteria, this method is recommended by the multiple advantages of using it.

Thus, the main advantages of using this method are:

- it is a method for decision making process under uncertainty condition, that is adequate to be used in the case of innovation projects;
- it allows the evaluation of an innovation project using quantitative criteria as well as qualitative criteria;
- it presents a long time run approach of the efficiency of an innovation project;
- it allows the qualitative criteria and quantitative criteria aggregation through a non dimensional entity: the utility;
- it combines the traditional selection methods with the modern ones;
- it admits the different contribution of a number of evaluation criteria to the innovation project's success;

- it offers the possibility to select the variant of the project that optimum complies with the planned objectives;
- it may be used for the evaluation of different variants of the same project as well as for the evaluation of an innovation project, at different moments and in different stages of progress.

5. Conclusion

The criteria used for the innovation projects evaluation prove the variety of factors that affect the global efficiency of those projects. Usually, an innovation project's failure is caused by ignoring some critically success factors.

The selection of the most relevant criteria for the innovation projects evaluation and the correct use of those criteria aim to decrease the uncertainty degree of the innovation process.

The economic practices proved that there is not a generally valid method for the all types of projects. More than that, the known global evaluation systems for the innovation projects doesn't assure the optimum combination between simplicity and precision. Those systems don't allow eliminating the natural uncertainty referring to the available information about the innovation projects.

In the innovation project's evaluation process the evaluation method used is essentially for the objectivity and accurate value of results but the quality of the project manager appreciation cannot be equaled by the mechanicals evaluation methods.

Project manager is the person that adopts an evaluation method or methodology considered adequate to the specific and the objectives of the innovation project. The manager's experience and skills allows creating an ensemble vision about the value of the project. Thus, the quality of the evaluation process has at least the same importance as the evaluation method used for the project selection decisions.

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