INNOVATIVE MONITORING TOOL FOR ENVIRONMENTAL ISSUES WITHIN PROJECT MANAGEMENT

Florin Tache, Associated Professor, PhD Candidate
Oana-Cătălina Ţăpurică, Associated Professor, PhD Candidate
Cristina-Elena Ispăşoiu, Student
Faculty of Management
Bucharest University of Economic Studies, Romania

Introduction

Scientific literature certifies more and more that the economic entities that do not organize their strategic activities using projects, in order to imply the most efficient and competent human resources in the organisation, are exposed to major risks (Zeng, et al., 2007) that can lead from losing the position detained on a certain market (Danilovic and Borwning, 2007) to business failure (Aubry et al, 2008). Within the projects portofolio of an organisation, utterly important, under the pressure of new economy, are *the projects that present a considerable impact on the environment*, where, beyond economic objectives, interfere some social and ecological arguments that determine the success of the project.

More than that, while monitoring these projects from economic point of view is not very complicated, monitoring the compliance with the social and ecological objectives and actions is highly difficult, making hard, therefore, to evaluate, in a correct and precise manner, the costs and the social benefits associated with a strategic endeavour or with an investment project (Hahn and Litan, 2005).

Literature review

The increasing importance that international economic, political and legislative institutions give to environment issues, materialized in the permanent enrichment of the environmental legislation, became an important factor in the reconfiguration of general strategies of economic organisations, in the sense of their orientation to an ecological perspective. Beginning with the year 1970, when the first scientific researches on the effects that economic activities have on the environment, were made, most of the societies adopted *a re-active attitude* to this matter (Gladwin, 1993). Contemporary strategic management is based on three dimensions of the sustainable enterprise (Nicolescu and Nicolescu, 2005), referred to economic dimension, social dimension and ecological dimension. Each of these dimensions, transposed in a project management plan, implies the development of some inherent tools of monitoring and evaluation (Chen, 2011).

Lately, the scientific literature emphasizes the absence of some monitoring and evaluation tools to provide project managers with complete and relevant information regarding project development in terms of ecological and/or social objectives. Under these circumstances, we assess the neccesity of developing some functional monitoring and evaluation project progress tools, in terms of their environmental impact.

So far, the attempts to quantify non-economic objectives, such as *social welfare*, *abatement and pollution control, biodiversity, or the evalution of satisfaction degree and population health level,* have led to the emergence of new specific methodologies, which were not widely accepted in the management project context. Thus, the most

used tool for (partially) monitoring the progress of a project from ecological and social points of view is the *cost-benefit analysis*, subject to the fact that this tool generates only punctual estimations of the values, without taking into consideration risk and uncertainty analysis (Stead and Stead, 2003).

Under these circumstances, *the paper presents an innovative tool for the selection of the most adequate methods and techniques of project monitoring in terms of environmental protection*, from a predefined set of similar methods and procedures, generically called *monitoring and evaluation key factors diagram*. The tool is not necessarily a monitoring tool itself, capable of replacing one of the classic methods or techniques, but rather a methodological mechanism for adopting the most adequate decisions regarding the tools with which the process of monitoring and evaluation the environmental aspects will perform, taking into consideration a set of restrictions related to stakeholders expectations, human resources availability, or to the impact dimension that every project has on the environment.

Objective

The paper presents the methodological steps of development and implementation of an innovative tool, compatible with project management principles, which aims to monitor and evaluate large projects, in terms of adequate the compliance to the objectives and actions of environmental protection.

Developing the Mechanism

Obtaining the structured form of the monitoring and evaluation key factors diagram demands a set of procedural stages, such as:

1.We define the range $\{[m]_j\}$, $j=\overline{1,p}$, as the range of techniques, methods and tools for monitoring and evaluation available in the context of project management used in the organisation.

The range $\{[m]_j\}$ represents the assembly of techniques, tools, methods and mechanisms used daily in the organisation that implements the project, for exercising the monitoring and evaluation processes. This range can include classic tools for monitoring the impact, generically defined (for example, m_1 = Impact Analysis; m_2 = Cost-Benefit Analysis, etc.), or even methods that are not formally recognized in the scientific literature, but which were previously used in the organisation (m_3 = Kick Off Assessment; m_4 = Pollution Matrix, etc.). A very important aspect that requires special attention and has to be taken into consideration when substantiating the content of the range $\{[m]_j\}$ is represented by the condition that asserts the fact that the methods which constitutes the range elements have to be available in the organisation, otherwise, there is the risk that the diagram can not be established, and the efficiency of the method become null.

2.We define the range $\{f_i\}$, $i=\overline{1,n}$, as the range of the variables that can be enclosed to the monitoring process and which are important for one or more stakeholders involved in these projects.

The range $\{[f]_i\}$ represents the assembly of the monitoring and evaluation factors, respectively those variables which, according to the approach based on stakeholders, represent critical areas that must be submitted to monitoring and evaluation process, in order to assure compliance with environmental demands.

Usually, this range includes factors that are direct related to the components of a project (terms, resources, etc), but also factors which are indirect related to them (deadlines, the amount of waste produced, the level of pollution abatement costs, etc.)

Thus, it results a range compound by a variable number of elements, each element of the range being an element that can be enclosed to a process of monitoring and evaluation, depending on stakeholders options (investors, beneficiaries, project managers, sponsors, etc.) at a certain moment.

3.We define the matrix $C_{f,m}$, as the compatibility matrix between the elements of the range $\{m_j\}$, j=$\overline{1,p}$, and the elements of the range $\{[f]_i\}$, i=$\overline{1,n}$, having the following form:

$$\begin{array}{c} \\ f_1 \\ f_2 \\ f_3 \\ \cdots \\ \cdots \\ f_n \end{array} \begin{array}{c} \begin{array}{cccccc} m_1 & m_2 & m_3 & \cdots & \cdots & m_p \end{array} \\ \begin{pmatrix} c_{11} & c_{12} & c_{13} & \cdots & \cdots & c_{1p} \\ c_{21} & c_{22} & c_{23} & \cdots & \cdots & c_{2p} \\ c_{31} & c_{32} & c_{33} & \cdots & \cdots & c_{3p} \\ \cdots & \cdots & \cdots & \ddots & \ddots & \cdots \\ \cdots & \cdots & \cdots & \ddots & \ddots & \cdots \\ c_{n1} & c_{n2} & c_{n3} & \cdots & \cdots & c_{np} \end{pmatrix} \end{array}$$

, where:

$\{m_1, m_2, m_3, \ldots, m_p\}$ = the range of techniques, methods and tools for monitoring and evaluation the environmental impact available in the context of project management carried out in the organisation;

$\{f_1, f_2, f_3, \ldots, f_n\}$ = the range of key variables that can be enclosed to monitoring and evaluation process and which are important for one or more stakeholders involved in these projects;

c_{ij}, $i=\overline{1,n}$ *şi* $j=\overline{1,p}$ = the compatibility coefficient between the factor f_i and the monitoring method m_j;

The elements of the range $\{c_{ij}\}$ verifies the relation:

$$\sum_{i=1}^{n} c_{i1} = \sum_{i=1}^{n} c_{i2} = \sum_{i=1}^{n} c_{i3} = \cdots = \sum_{i=1}^{n} c_{ip} = 1$$

The compatibility matrix represents the first stage in building the monitoring and evaluation key factors diagram, because it generates the future configuration of the diagram and it reflects the precision of building it.

The matrix gathers on its rows all the elements of the range $\{[m]_j\}$ and on its columns all the elements of the range $\{[f]_i\}$, resulting a matrix with the dimensions *i* x *j*, at the intersection of its rows with its columns being a so called compatibility coefficient, expressing to what extent the element $\{m_j\}$ can be used for monitoring the key factor $\{[f]_i\}$.

4.We define the subset $\{[F]_i\}$, $i=\overline{1,q}$, $q \leq n$, as the subset of the key variables considered relevant by the decision makers (investors, project managers, main stakeholders) for monitoring and evaluation in order to assure the compliance with the environmental objectives within a certain project.

Taking into account the peculiarity of each project, in a certain context, some elements of the range $\{[f]_i\}$ can be considered relevant (key), in relation to others, whose importance is considered to be nonessential, or even insignificant according to the perception of decisional factors.

Therefore, in the situation of a certain project, decision makers will extract a subset of the range $\{f\}_i$ that will contain only the elements of the range $\{f\}_i$ which are relevant in the context of the project.

5.We define the subset $\{M\}_j$, $j=\overline{1,r}$, $r \leq p$ as the subset of the monitoring and evaluation methods and tools compatible with the key variables considered relevant by the decision makers, by checking the following condition detained by all the elements of the range:

M_j = {m_j, $j = q$, with the condition that m_j corresponds to that compatibility coefficient that verifies the relation: $\max_{p\,ip}$, where i=$\overline{1,q}$, $q \leq n$ }

Similar to the procedure of the previous step, there is possible that not all the monitoring and evaluation methods and tools which constitutes the elements of the range $\{m\}_j$ to be recommended for exercising the processes of monitoring and evaluation within a certain project. If the number of key factors previously defined (the elements of the range $\{F\}_i$) is relatively reduced, then the number of monitoring and evaluation methods selected will be the same.

For example, we consider the following elements which belong to a simplified situation, where the decision makers have already selected the elements of the subset $\{F\}_i$:

• the range m_j = {m_1 = Impact Analysis, m_2 = The Logical Framework Matrix, m_3 = Cost-Benefit Analysis, m_4 = Rojanschi Method, m_5 = Pollution Abatement Costs Method, m_6 = Environmental Benchmarking}

• the range F_i = {f_1 = the amount of waste emitted into the atmosphere, f_2 = the fulfillment of deadlines, f_3 = the compliance to the budgeted amounts, f_4 = the relation between costs and benefits, f_4 = other factors}

In this situation, compatibility matrix will have the following shape:

$$\begin{array}{c} \\ f_1 \\ f_2 \\ f_3 \\ f_4 \\ f_5 \end{array} \begin{array}{c} \begin{array}{cccccc} m_1 & m_2 & m_3 & m_4 & m_5 & m_6 \end{array} \\ \begin{pmatrix} 0{,}60 & 0{,}05 & 0{,}15 & 0{,}10 & 0{,}15 & 0{,}10 \\ 0{,}05 & 0{,}25 & 0{,}00 & 0{,}00 & 0{,}00 & 0{,}10 \\ 0{,}15 & 0{,}15 & 0{,}20 & 0{,}15 & 0{,}25 & 0{,}10 \\ 0{,}15 & 0{,}05 & 0{,}60 & 0{,}15 & 0{,}10 & 0{,}00 \\ 0{,}05 & 0{,}50 & 0{,}05 & 0{,}60 & 0{,}50 & 0{,}70 \end{pmatrix} \end{array},$$

where f_5 represents the aggregate expression of the other elements of the range f_i, which do not belong to the set $\{F\}_i$.

The algorithm of defining the elements of the range $\{M\}_j$ leads to the fact that for monitoring and evaluation of f_1 the most appropriate method is m_1; for monitoring and evaluation of f_2 the most appropriate method is m_2; for monitoring and evaluation of f_3 the most appropriate method is m_5, and for monitoring and evaluation of f_4 the most appropriate method is m_3. Therefore, the range M_j will contain the elements {m_1, m_2, m_3, m_5}.

6.We define the individual relations between the elements of the subset $\{F_i\}$, $i=\overline{1,q}$, $q \leq n$ and $\{M\}_j$, $j=\overline{1,r}$, $r \leq p$, under a procedural form (inputs – outputs), in matrix and graphical form, resulting:

- the matrix of monitoring and evaluation inputs;
- the matrix of monitoring and evaluation outputs;
- the diagram of monitoring and evaluation inputs and outputs.

Once the components of the sets $\{F_i\}$ and $\{M_j\}$ were established, there were practically established the components of the monitoring and evaluation key factors diagram.

Subsequently, we apply the condition according to which each key factor (component of the range $\{[F]_i\}$) represents an input for one of the elements of the range $\{[M]_j\}$ and each output of the elements of the range $\{M_j\}$ represents a key factor which interconnects the elements of the two sets, similar to the elements of a system.

Thus, it results the monitoring and evaluation inputs matrix and the monitoring and evaluation outputs matrix, which are simplified matrix representations of the monitoring and evaluation key factor diagram as long as are fullfilled the following defining rules:

- the monitoring and evaluation inputs matrix

$$\begin{array}{c} \\ F_1 \\ F_2 \\ F_3 \\ \cdots \\ \cdots \\ F_q \end{array} \begin{array}{c} \begin{array}{cccccc} M_1 & M_2 & M_3 & \cdots & \cdots & M_r \end{array} \\ \begin{pmatrix} e_{11} & e_{12} & e_{13} & \cdots & \cdots & e_{1r} \\ e_{21} & e_{22} & e_{23} & \cdots & \cdots & e_{2r} \\ e_{31} & e_{32} & e_{33} & \cdots & \cdots & e_{3r} \\ \cdots & \cdots & \cdots & \ddots & \ddots & \cdots \\ \cdots & \cdots & \cdots & \ddots & \ddots & \cdots \\ e_{q1} & e_{q2} & e_{q3} & \cdots & \cdots & e_{qr} \end{pmatrix} \end{array}$$

, where

$\{M_1, M_2, M_3, \ldots, M_r\}$ = the subset of the monitoring and evaluation methods and tools compatible with the key variables considered relevant by the decision makers

$\{F_1, F_2, F_3, \ldots, F_n\}$ = the subset of the key variables considered relevant by the decision makers

e_{cd}, c=$\overline{1,q}$ şi d=$\overline{1,r}$ =

$$\begin{cases} 1, \textit{if the variable } F_c \textit{ is an input for the method } M_d \\ 0, \textit{if the variable } F_c \textit{ is not an input for the method } M_d \end{cases}$$

The monitoring inputs matrix connects the process of planning to the process of monitoring, because there are expected values of the monitoring key factors are entered, while the monitoring outputs matrix connects the monitoring process to the evaluation process, because it presents an advanced perspective on compliance planning with the implementation of the projects.

- the monitoring and evaluation outputs matrix

$$\begin{array}{c} \\ F'_1 \\ F'_2 \\ F'_3 \\ \cdots \\ \cdots \\ F'_q \end{array} \begin{array}{c} \begin{array}{cccccc} M'_1 & M'_2 & M'_3 & \cdots & \cdots & M'_r \end{array} \\ \begin{pmatrix} e'_{11} & e'_{12} & e'_{13} & \cdots & \cdots & e'_{1r} \\ e'_{21} & e'_{22} & e'_{23} & \cdots & \cdots & e'_{2r} \\ e'_{31} & e'_{32} & e'_{33} & \cdots & \cdots & e'_{3r} \\ \cdots & \cdots & \cdots & \ddots & \ddots & \cdots \\ \cdots & \cdots & \cdots & \ddots & \ddots & \cdots \\ e'_{q1} & e'_{q2} & e'_{q3} & \cdots & \cdots & e'_{qr} \end{pmatrix} \end{array}$$

, where

$\{M'_1, M'_2, M'_3, \ldots, M'_r\}$ = the subset of monitoring and evaluation methods and tools compatible with the key variables considered relevant by the decision makers;

$\{F'_1, F'_2, F'_3, \ldots, F'_q\}$ = the subset of the key variables considered relevant by the

decision makers;

e'_{cd}, c=$\overline{1,q}$ şi d=$\overline{1,r}$ =

$$\begin{cases} 1, \text{if the variable } F'_c \text{ is an output for the method } M_d; \\ 0, \text{if the variable } F'_c \text{ is not an output for the method } M_d \end{cases}$$

After concluding this matrix representation, we can built a simplified diagram of the monitoring and evaluation of inputs and outputs, such as the one presented in Figure 1.

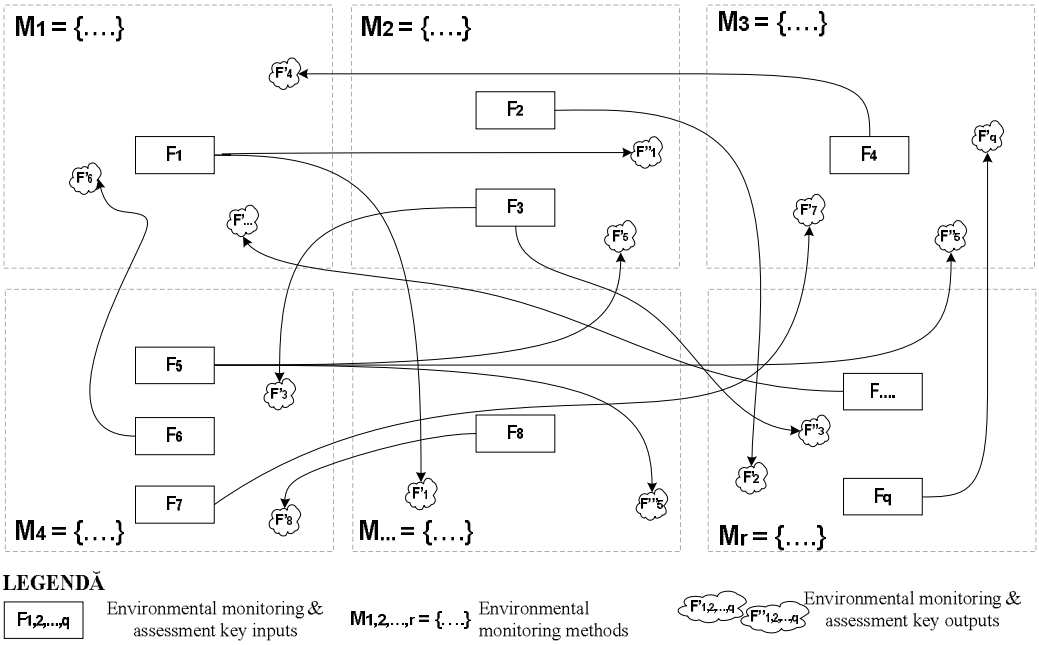

Figure 1. The simplified diagram of the monitoring and evaluation of inputs and outputs

Conclusions

Despite some obvious limitations, mainly determined, on one side, by the level of subjectiveness that interferes within the method, and, on the other side, by the potential of the organisation that implements the project (or, as may be, who is the beneficiary of it) the tool can represent a solution to some still delicate issues associated to exercising the monitoring and evaluation processes within project management, at the social and ecological aspects level, such as empiricism in selecting the monitoring methods, the absence of scientific managerial tools used for monitoring and evaluation projects in terms of compliance with the labor protection rules, or the absence of some customizable, unstandardized monitoring and evaluation tools, but which are applied on a large scale in the field of social and ecological activities.

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Oana-Cătălina Ţăpurică
Cristina-Elena Ispăşoiu
Bucharest University of Economic Studies, Romania

Abstract

The paper aims to present an innovative monitoring and evaluation tool for environmental issues within project management. We provide a short literature review on monitoring tools approaches and we emphasize the fact that the most used tool within an organisation is the cost-benefit analysis, even though it has some inconveniences. In response to these inconveniences we propose an innovative tool, the monitoring and evaluation key factors diagram. Therefore, the paper presents the methodology that has to be undertaken in a company in order to implement the diagram and, thus, to solve the environmental issues that project managers cope with.

Keywords: project, project management, monitoring, environment, diagram, ecological