THE EFFICIENCY OF TRANSPORT INFRASTRUCTURE PROJECTS IN A SUSTAINABLE DEVELOPMENT CONCEPT. THE EFFICIENCY COMPOSITE MODEL APPROACH

Petru NICOLAE, Ec., PhD Student,
SC Geostud SRL, Bucharest, Romania;
School of Advanced Studies of the Romanian Academy, nicolae.petru@geostud.ro

ABSTRACT: *Over time, mankind has gone through various world crises, which have determined the adaptation of the systems and principles on which societies based their existence to the realities and challenges of that time. This process was achieved through the emergence of new methods of evaluating the efficiency of project planning and implementation in relation to the needs of sustainable development.*
The research aims to identify the elements and divisions that enter in the composition of a congruence coefficient (corresponding to an optimal point), which will help the efficiency of transport infrastructure projects, in the context of sustainable development, to be properly evaluated. This paper presents the synergy between the concept of efficiency and sustainable development, which has acquired forms, causalities and influences determined by the intensification of concerns regarding solutions for adapting to the effects of climate change and mitigating it and by the evolution of globalization processes.

Keywords: *sustainable development, transport infrastructure, climate change, environment, biodiversity, taxonomy.*

JEL Classification: *Q01, Q54, Q56, R42*

1. INTRODUCTION

The main objective of this research was to determine the components of a congruence coefficient, to properly evaluate the efficiency of transport infrastructure projects.

The desideratum of the concept of sustainable development is based on its three pillars, namely: economic, social and environmental, strongly expressing the need to implement a taxonomy and a global methodology for determining the economic efficiency at the level of each project in relation to absolute interdependence with environmental efficiency and society (Zaman, 2014).

Sustainable development refers to the importance of how energy, natural, informational, material, environmental and financial resources are managed, in order for future generations to have access to the same amount of resources related to the level of demand or similar alternatives, without affecting the quality of life or the integrity of the environment in which they live (Neaga, 2015).

The way in which this is achieved is currently assessed, for each project separately, by determining the degree of efficiency, based on defined or well-defined criteria.

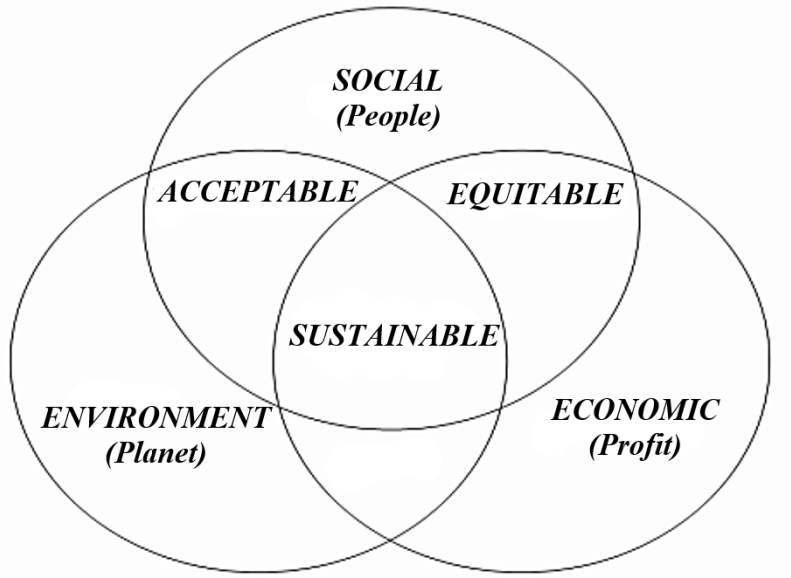
The idea of efficiency has undergone over time transformations in strict relation to the development directions established globally through summits and protocols assumed by the countries that have become active participants in the sustainability concerns of the projects.

The efficiency is a complex concept that involves identifying a balance between the pillars of sustainable development, by implementing solid principles of social equity, circular

economy, continuous adaptability to the changes of the Planet, multidisciplinary, innovation and anticipation of the needs of future generations.

The efficiency of a project is related to its durability over time, in the context of achieving a level of balance of the components that define the concept of sustainability. (Figure 1).

Figure 1. Sustainable development and the area of congruence between the three constituent pillars: social, economic, and environmental - adaptation after



Sources: UCN, 2006, The future of Sustainability. Rethinking Environment and Development in the Twenty-first Century, Report of IUCN

2. LITERATURE REVIEW

According to Dyllick and Hockerts, sustainable development can only be achieved when the following criteria are met simultaneously: "eco-efficiency, socio-efficiency, sufficiency and equity". All these theories are subject to their own interpretation by specialists, and to reduce the factor of variability caused by "expert-opinion" ("opinion based on the expertise and experience of the developer"), it is necessary a thorough research of all elements that can form the basis of regulations, both taxonomic on efficiency, but also on a method of unit evaluation.

Environmental protection objectives relevant to the verification of the degree of efficiency of plans or projects shall consider the following:

- environmental objectives set through existing national and European strategies, programs, plans, policies and regulations;
- the relevant aspects of environmental protection and the dynamics of changing environmental parameters;
- cooperation of policies, programs, plans, strategies, and regulations relevant to the objectives of the analyzed plan with those for the existing transport sector at national and European level.

In present time, in order to be able to properly assess the efficiency of transport infrastructure projects, it is necessary to take into account the following legislative and regulatory acts.:

a) The Objectives set by the National Recovery and Resilience Plan (NRRP) 2021-2027

b) The Strategy for sustainable transport for the period 2007-2013 and 2020, 2030
c) Romania's National Strategy on Climate Change 2013 – 2020
d) National Strategy for Sustainable Development of Romania Horizons 2013 – 2020 – 2030
e) The national action plan 2016 - 2020 on climate change
f) Sustainable Urban Mobility Plans or local/ regional air quality plans, 2016-2030
g) The White Paper on Transport/ Transport White Book
h) Europe 2020 Strategy
i) EU Green Paper on Urban Mobility, "Towards a New Culture of Urban Mobility"
j) EU Sustainable Development Strategy
k) technical guidelines on the application of the "do no significant harm" principle under the Recovery and Resilience Mechanism Regulation (DNSH)

3. METHODOLOGY

From a methodological point of view, the following methods, tools and procedures were used:

a. accumulations and outcomes from the specialized literature
b. best practices of other countries
c. own data processing, figures, and tables to describe conceptual relationships
d. comparison between current and proposed methodology

The main data sources are:
- EU Parliament, 2020, *Sustainable finance – EU taxonomy, A framework to facilitate sustainable investment*
- EU Parliament, 2014, *The Core Network Corridors Progress Report*
- European Commission, 2019, *Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Review of Progress on Implementation of the EU Green Infrastructure Strategy*, Bruxelles

4. RESULTS AND DISCUSSIONS

Establishing the efficiency of projects. Main theoretical and practical approaches

In order to determine the efficiency of a transport infrastructure project, several actions are carried out, depending on the implementation phase of the project. (Figure 2).

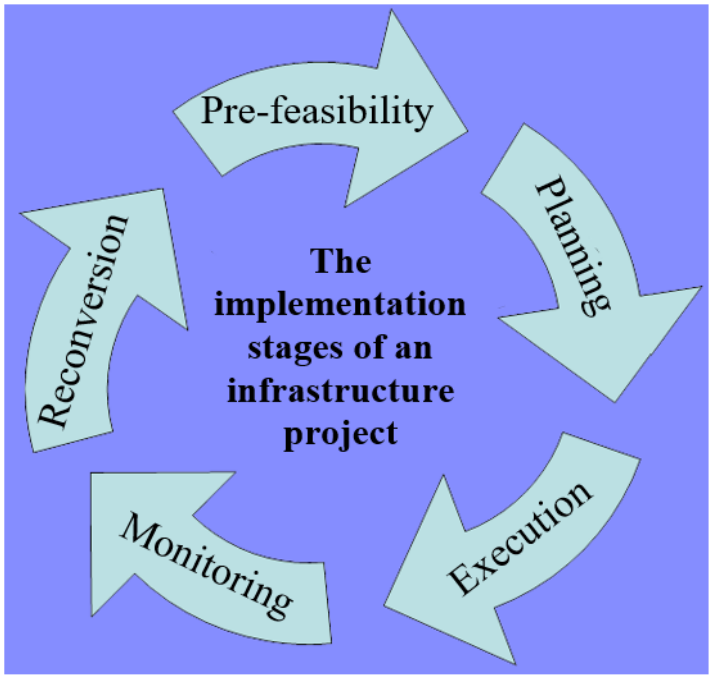
Pre-planning stage

In this stage, the idea and the capacity to materialize it are analyzed based on the following aspects:
- internationally established development directions (Necessity);
- the potential for implementation at the level of a region and possible general guidelines for preparation, implementation and management (Possibility);
- constraints in carrying out the project identified based on pre-existing information about the area in which the project is to be implemented (Risks);
- complementarity or connectivity with the projects already implemented (Integration and Cumulative Impact);

- the potential for innovation and the ability to adapt to current development concepts (Sustainable Development).

This first stage does not define the physical characteristics or constituent elements of the project or plan but analyzes the applicability of the project and the area in which it is most feasible to be implemented. This removes all the general constraints already known and the approach is meant to save resources allocated to the planning process.

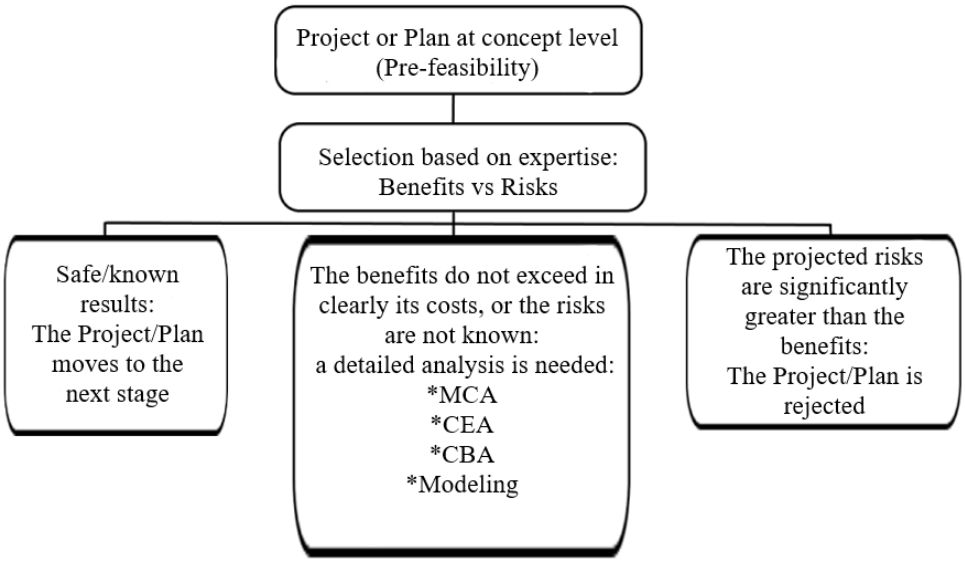
Figure 2. Life cycle of an infrastructure project



Planning stage

At this stage, an extensive detail and deepening is required for the investment holders to know in detail the benefits and risks, so that the planning stage is carried out while avoiding any blockages that may occur. This stage is carried out based on initial multicriteria analysis (MCA) studies, cost-benefit analyzes (CBA), cost-efficiency analyzes (CEA) or based on complex modeling. For projects or plans that already have a general analysis at regional level, which are classified as "safe" projects, with expected and known results, such an analysis is no longer required, although any local implementation has its own constraints and risks. For the other projects, such an evaluation is required to be able to move on to the next stages (Figure 3).

Figure 3. Stages of the project evaluation process in terms of sustainable benefits balance - risks and significant impact



The first step in verifying the efficiency of the project in the context of sustainability is to establish certain route options, also called the "long list of options".

The contoured route alternatives are subsequently compared with each other through an efficiency indicator established based on detailed studies described below.

Multicriteria analysis is a method of qualitative and quantitative assessment that integrates all relevant criteria and sub-criteria that define the interaction project - environment - economic and social implications, such as:

- environmental factors water, air, soil, biodiversity; the effects generated by the project implementation and all other elements that may generate effects on the environment are analyzed, thus defining its area of influence (elements of conservative importance affected by the project, affected protected natural sites, effect on interconnectivity between ecological sites or corridors, impact over time on environmental factors, etc.);
- elements of archaeological and cultural importance;
- projects in progress or to be implemented in the area of interest for the project and the interaction between them and the environment (transport routes and possible blockages, greenhouse gases, noise or other pollution generated by cumulative effect, etc.);
- execution technologies;
- raw materials used and waste generated by the project;
- the ability to use recyclable materials and the ability to integrate components with a shorter lifespan than the project into the concept of circular economy;
- the study on the adaptation of the project to climate change;
- the amount of greenhouse gas emissions generated by the change in land use category and the measures needed to be implemented to recover them in accordance with internationally set targets;
- the general costs associated with the execution of the project, by categories of works, not by well-defined technical solutions (at the level of preliminary analysis);
- the number of people affected by the implementation of the project through expropriations, demolition, noise, vibration, limiting their access to resources, etc.;

- other elements that may be foreseen at the time of drawing up the pre-feasibility project.

Stages of execution, exploitation and conversion

The execution stage implements the solutions adopted in the project and treats any risks that may arise during construction. At this stage, environmental experts and specialists seek to implement existing measures and effects to determine their effectiveness, by reference to the baseline and the objectives set by the regulatory and authorizing acts of the project.

In the operation / exploitation stage of the project it's important, as in the other previous stages, the activity of monitoring the effectiveness of the project, as part of the evaluation of its efficiency, carried out through the following activities:

-field trips of qualified personnel to inventory the characteristics of all species and habitats in the analyzed area;
- assessment of habitat restoration capacity and identification of crop associations in affected areas during the construction period and on newly created structures;
- assessment/evaluation of the dynamics and impact of invasive plants;
- assessment of the extent/magnitude of the impact produced by the project (through collision, mortality, noise, accidental pollution, etc.) on species of wild fauna;
- assessing the effectiveness of impact reduction measures;
- evaluation of the effectiveness of the solutions adopted for the permeability of species;
- effective verification of protection measures and implementation of new measures for unforeseeable situations.

In addition to the existing challenges resulting from the physical implementation of the project, the risk associated with the effect of obsolescence brings additional pressure to the processes of establishing its efficiency.

If a transport infrastructure project ends up being technologically worn out, it re-enters the analysis process, this time to identify possibilities for conversion or improvement, to be able to continue to meet existing standards and to be declared effective from the point of view of sustainable development.

It is obvious that to be able to develop a transport project, it is necessary to allocate sufficient time to the analyzes on its efficiency in the context of climate change, and this is done with a well-organized and complete team of specialists.

For the result of the evaluation of the efficiency level to be the best possible, it is necessary to have a system of rules and methods to ensure bidirectional collaboration at interinstitutional and personal level of all factors involved in the analysis process and those directly or indirectly affected by realization of the project.

The evaluation methods, although they are included in the normative and legislative acts, depend on the capacity of the developers/ evaluators to integrate the obtained data, to identify the risks associated with the implementation of the project in relation to the environment and to foresee the possible risks that may generate unjustified or inefficient consumption of resources.

In other words, the analysis of the efficiency of projects implies an integration of several fields, which ultimately results in a constructive solution, based on the opinions of several specialists, each of whom has a certain degree of subjectivity.

Local technological knowledge, cultural belongings, or the level of training of the experts involved in the analysis can lead to different results and levels of efficiency, which creates problems of efficient management from the point of view of the correct implementation of the measures established at global level.

If the analysis processes at the local level differ from each other, we cannot say that the notion of efficiency is a term unanimously understood and applied uniformly, thus integrating this practice of establishing the degree of efficiency into the Latin proverb "*non idem est si duo dicunt idem*" (Eng.: "it is not the same when two say the same").

5. CONCLUSIONS

The research aims to underline the necessity of a detailed analysis for each method that enters the calculation of economic, social and environmental efficiency, in order to ensure an adequate and complete approach to the evaluation process.

Based on the data used, the subcomponents of each criterion must be investigated and cumulated to identify the particularities that enter in the structure of the efficiency composite, in correlation with the European requirements.

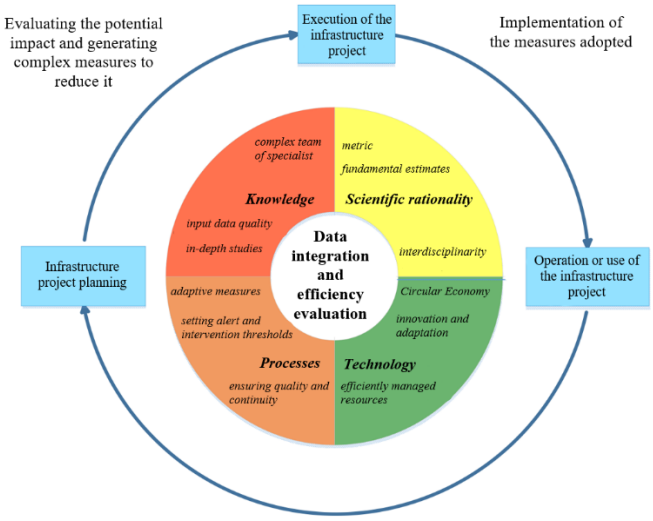
The integrated data will be merged to identify the net benefits and to quantify the usefulness of a responsible, complex and unitary management approach to the evaluation process, that maximizes the potential for using the project in relation to the three components of the principle of sustainable development.

This approach will be based on a research basis for identifying an optimal factor that include all current elements on concepts and trends about sustainability, sustainable development and the circular economy.

The proposed complex model will allow the possibility of unitary definition of efficiency of transport infrastructure projects, incorporating the multi-criteria elements of each determining factor into a single factor called efficiency composite. The efficiency composite, whose valences will also be demonstrated through a case study, will combine and adapt different evaluation methods existing at national and international level and will develop a process based on a multicriterial analysis, which offers a new holistic approach.

The objective of the proposed research is to provide a starting point in terms of a modern experience regarding environmental protection in Romania, in the context of the road infrastructure and at the same time, to serve as a decision-making tool for financing investments in Romania. (Figure 4).

Figure 4. Components of the process of defining the efficiency of an infrastructure project



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