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# Mathematical Approach for Ex-ante Evaluation of Projects Funded by European Funds in State University

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**Abstract.** Effective projects implementation, funded by European funds in state universities directly depends on objective characteristics. On the other side, each university has its own specific characteristics. These features form the university's project capacity. Poor quality of project implementation or the direct failure of any project leads to financial losses for organization or the financial source. But even more importantly – the university is unable to achieve its project goals. This is the reason that determines the necessity of methodology that helps university to plan and prepare only those projects which is capable objectively accomplish successfully. The aim of this study is to present an approach for ex-ante evaluation of project capacity of state university.

## INTRODUCTION

The dynamic and highly competitive environment in which state universities exist and have to develop, as well as all legislative requirements on the other side, related to the economy, effectiveness and efficiency of all activities [6] pose serious questions and in the same time strict requirements and challenges from the very beginning of preparation phase of project proposals. Their fulfillment should give confidence to the management of the educational institution in the following directions:

1. After signing the contract for project funding, the university to be able to implement project and all project indicators to be reached;
2. During its implementation phase the project will not overburden the budget of the state university and to put at risk its main educational and scientific activities;
3. For funding by the European programmes and funds will be proposed such project that corresponds to the priorities of the state university and from the all other options this is the project that contributes the most to their achievement.

Those requirements, which must be set by each university before prepare and submit a project proposal, are based on the following specifics:

1. After signing the agreement with the Contracting Authority, the state university is fully responsible (including through its budget) for the implementation of all activities with the same quality and specification presented in the project. Any negligence of project activities or differences from the originally determined commitment without official permission of the relevant Contracting Authority could results to the refusal of accepting these costs as eligible and/or financial corrections to be made to the university – beneficiary of the project. The state university therefore is obliged to determine at a preparation stage if is capable to guarantee the implementation of all activities

presented in the project proposal in the determined volume, quality and timelines. This analysis has to cover as well as all activities that are not directly implemented by the university but are the consequences of contracts signed by the university and different business organizations, for whose activities, by contract, the university has fully financial responsibility.

2. State universities are very specific educational organizations. They have no right to take on an obligation to the financial institutions. The sale of tangible fixed assets does not result on the increasing of their budget. Their own revenues they may have are strictly defined in compliance with the applicable legal requirements and are related to their main educational and scientific activities. Major part of the state university budget is formed by the subsidies to guarantee implementation of their core activities and as well as from the students fees, coming within strictly specified calendar deadlines. Therefore one state university has a precisely defined budget, subject of rigorous planning and control through which the educational and scientific activities of the university have to be implemented and developed. Only the positive difference between financial resources needed for normal execution of main activities and disposable resources in the concrete period of time could give the possibility of the university to enable workflows to be allocated for the financial project implementation. The last one forms so-called budgetary capacity, part of the financial capacity of organization [1]. Overtaking the budget capacity leads to a number of negative consequences [1] and as a result – to the inability to ensure financial resources for the main activities of the university.

3. Very often project funding, including those under European programmes and projects is the only one possibility for university to develop and to achieve competitive advantage having in mind the initial financial resources coming from the national budget or from students' fees. Since financial resources are very limited and the environment in the field of higher education is really competitive and strong it is obvious that only project proposals that contribute to a maximum degree in achieving very specific parts of the university strategy goals have to be submitted. Unfocused budget capacity dedicated to activities that will not contribute to the organization development is inappropriate.

### **General sequence of the mathematical approach for ex-ante evaluation of projects**

The methodology proposed in this section of the paper specifies the methodology for ex-ante monitoring and assessment [1] in a state university taking into account the above mentioned.

The objectives of the methodology are therefore to give confidence to the management body of the state university that all project proposals submitted to the contracting authorities by the university meet the requirements of economy, efficiency and effectiveness of activities and contribute to the fullest possible extent to achieve some of the university strategy goals.

The methodology establishes on one hand the project capacity of the state university, and on the other – key quality characteristics of the potential project proposals implementation and on the third side – the real benefits from their realization.

Methodology is divided into three modules that include in a logical manner the reasoning above (figure 1).

### **First phase**

The first phase is related to the evaluation of the project capacity of a state university. This module is determined on the bases of expert evaluation and retrospective analysis the components of the project capacity: administrative, financial, image, infrastructure. The mathematical instruments are used from [2, 4, 5].

In the process of defining image and infrastructure capacity the average assessment made by the experts is determined through (1).

$$\bar{X} = \frac{\sum_{i=1}^N x_i k_i}{\sum_{i=1}^N k_i} \quad (1)$$

where  $x_i$  is the ballot ratio given by i-th expert;  $k_i$  is the weight of the opinion of the i<sup>th</sup> expert; N- number of experts.

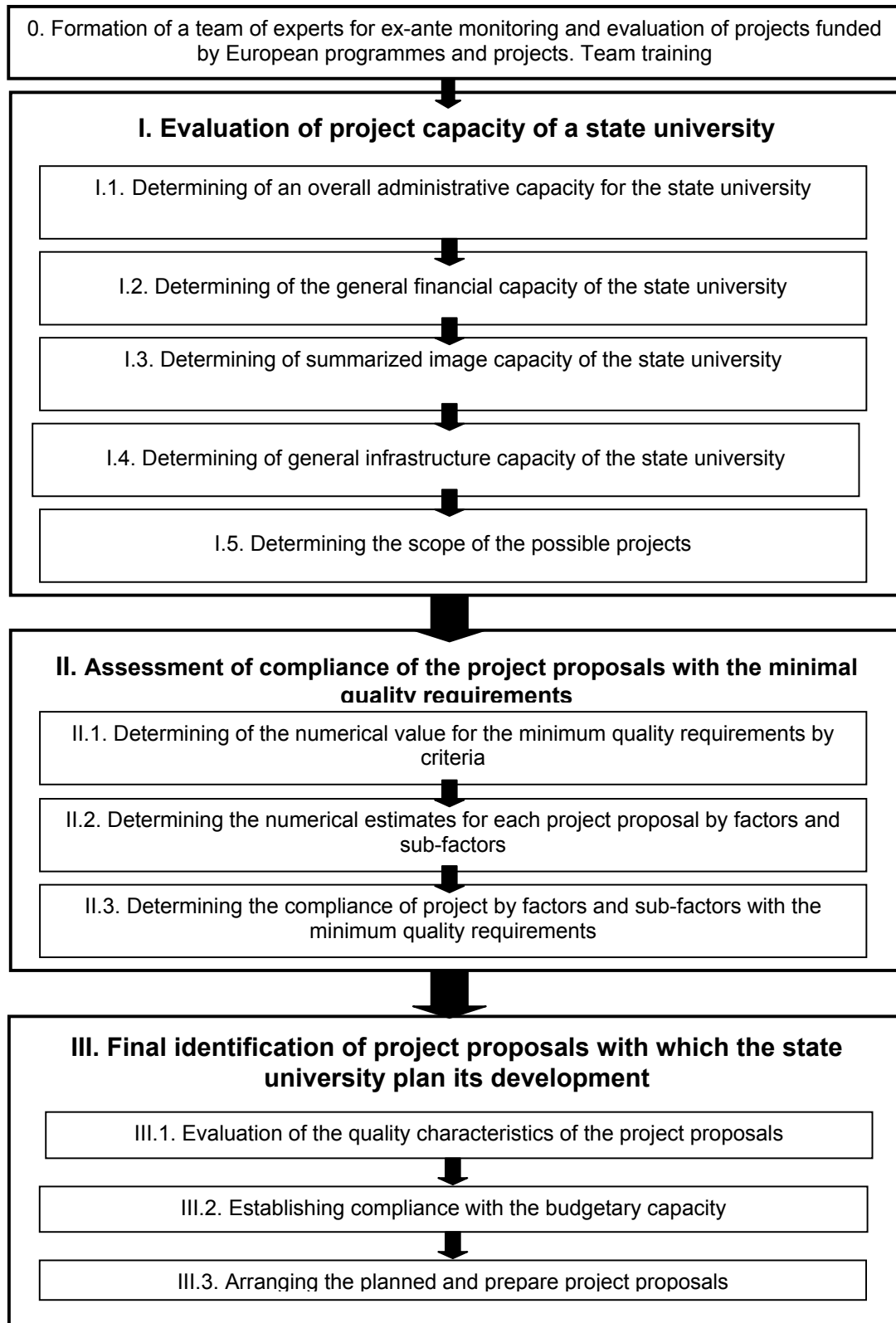


FIGURE 1. Methodology Algorithm

Dispersion provides us with information about the coordination of the experts' opinions (2). No degree of coordination is a sign for different opinions which needs to be further analyzed.

$$\sigma^2 = \frac{\sum_{i=1}^N (x_i - \bar{X})^2 k_i}{\sum_{i=1}^N k_i} \quad (2)$$

During the process of defining administrative and financial capacity the average evaluation is determined on the basis of three expert assessments: pessimistic, optimistic and the most probable one (3).

$$\bar{X} = \frac{\sum_{i=1}^N \frac{\sum_{j=1}^3 x_{ij} \alpha_j}{\sum_{j=1}^3 \alpha_j} k_i}{\sum_{i=1}^N k_i} \quad (3)$$

where  $\alpha_1$  is the weight of pessimistic assessment;  $\alpha_2$  is the weight of the most probable assessment;  $\alpha_3$  is the weight of optimistic assessment.

The inconsistency between different assessments made by different experts comes from (4).

$$\sigma^2 = \frac{\sum_{i=1}^N \sigma_i^2 k_i}{\sum_{i=1}^N k_i} + \frac{\sum_{i=1}^N (x_i - \bar{X})^2 k_i}{\sum_{i=1}^N k_i} \quad (4)$$

Where

$$\sigma_i^2 = \frac{(x_{i3} - x_{i1})^2}{\alpha_4} \text{ - Inconsistency between optimistic and pessimistic assessment of the } i^{\text{th}} \text{ expert}$$

$$\bar{X}_i = \frac{\sum_{j=1}^3 x_{ij} \alpha_j}{\sum_{j=1}^3 \alpha_j} \text{ - Average expert assessment of } i^{\text{th}} \text{ expert;}$$

$\alpha_4$  - A coefficient represented the uncertainty of a square of the  $i^{\text{th}}$  experts.

In [2, 4, 5] are proposed the following coefficient of weighting:  $\alpha_1 = 1$ ,  $\alpha_2 = 4$ ,  $\alpha_3 = 1$ ,  $\alpha_4 = 36$

Thus defined project capacity uniquely identifies the area of potential successful type of projects. This module is also an important benchmark for identifying weaknesses that need to be overcoming in terms of enhancing project funded opportunities. For instance participation in infrastructure projects is unacceptable due to proven gaps in the system of contractor selection or investor control.

## Second phase

The second phase is an assessment of the compliance of project proposal with the minimum quality requirements allowing its proper implementation and cross-check for activities realism. Check for the basic requirements commented in [1, 3] is also made.

These baseline requirements are evaluated by two experts selected from a preliminary defined pool of experts. Both experts possess equal weight in determination assessments for compliance with the minimal requirements. Experts can give ratings from 1 to 6 by using the following scale:

- 1 – complete lack of compliance with this criterion;
- 2 - very low compliance with this criterion;
- 3 – average compliance with this criterion;
- 4 – good compliance with this criterion;
- 5 – very good compliance with this criterion;
- 6 - fully compliance with this criterion.

In order to determine the average assessment is used (1). In case of large dispersion (2) the third expert is called and the average assessment is a result from the assessments of the three experts through (1).

A comparison is made with the minimum quality requirements (5).

$$\bar{Y} > C \tag{5}$$

Where

$C = \begin{vmatrix} C_1 & \dots & C_f \end{vmatrix}$  - Matrix of minimum quality requirements;

$C_f$  - Minimum assessment of  $f^{\text{th}}$  criterion

$\bar{Y}$  - Matrix of average assessments under the criteria for minimum quality requirements.

### Third phase

At this stage the selection of project proposals is made through which the university plans to submit in order to achieve financial support from different programmes and EU funds. At this stage for all project proposals that are successfully passed through cross-check (5) is carried out:

- Sub-phase 1: Evaluation of quality characteristics of project proposals where it is put to a value according to a predefined lists of requirements. The evaluation is executed by factors and sub-factors of the capacity of project proposal commented in [3] in condition on specification of methodology in [1].

The evaluation of each sub-factor in the project proposal is determined by two experts selected by the preliminary identifying pool of experts. Both experts possess equal weight in determination assessments of sub-factors whereby for the average score is used (1). In case of large dispersion of the two experts assessment (2) the third expert is called and the average assessment is a result from the assessments of the three experts through (1).

The assessments by factors of capacity of the project proposals are obtained from (5).

$$\bar{Z}^m = \bar{X}^m R^m \tag{6}$$

Where  $\bar{Z}^m$  - represents the general average assessment of  $m^{\text{th}}$  factor taking into account of weight / the impact of each of its sub-factors for each project proposal.

$$\bar{X}^m = \begin{vmatrix} \bar{X}_{11}^m & \dots & \bar{X}_{1k}^m \\ \dots & \dots & \dots \\ \bar{X}_{l1}^m & \dots & \bar{X}_{lk}^m \end{vmatrix}, \text{ matrix of the average values of sub-factors of } m^{\text{th}} \text{ factor}$$

for each project  $l$ ;

$$R^m = \begin{vmatrix} R_1^m & \dots & R_k^m \end{vmatrix}, \text{ matrix of coefficient of weight/ impact coefficient of sub-factors } k \text{ of } m^{\text{th}} \text{ factor.}$$

- Sub-phase 2: comparison and analysis of possibilities in the evaluation process of the budget capacity of state university. This sub-phase is related to the identification of the possible financial resources that will be allocated to co-financing and/or working capital connected to the proper implementation of some of the project activities.

- Sub-phase 3: project proposals arrangement and their distribution in several lists: list of rejected projects; list of waiting projects, list of submitted project proposal.

The assessments obtained in (6) form the general assessment of each project, covering all criteria  $\bar{L}$  (7).

$$\bar{L} = |L_1 \quad L_l| \quad (7)$$

The assessments obtained in (7) are rank in descending order and form a matrix of eligible projects which the state university plans to submit to the contracting authority. The selection procedure for project proposals starts with those with the highest rating and goes in descending order according to the budget limits allocated to this specific university policy.

## Conclusion

This paper presents an approach for ex-ante evaluation of project capacity of state university. The methodology provides reliable instrument for carrying out ex-ante monitoring and evaluation of project proposals, developed by the state universities with a serious potential to be funded by European programmes and projects. The methodology helps university to plan and prepare only those projects which is capable objectively accomplish successfully.

The methodology is a powerful instrument that allows university management to:

1. Remove project proposal that do not meet certain requirements of quality, or unrealistic projects or those that are currently unable to implement.
2. Evaluate and take into account budget and financial capacity of the university in accordance with the project proposals activities.
3. Arrange project proposals according to specific quality requirements and to identify only the best (to the extent of the budgetary capacity) that will be submitted to the contracting authorities for funding.

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