A Stage by Stage Procedure for Project Analysis, Evaluation, and Selection

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Abstract—A stage by stage selection mechanism for innovation and investment projects is considered. Instead of the traditional comparison based on the construction of an additive or multiplicative convolution function for numerous criteria to assess projects competing for resources, a sequential comparison of characteristics at the stages of their preparation is proposed. The procedure is consistent with the logic of target projects development and implementation, making it possible to significantly reduce the risk level during the analysis and selection of the best projects from those reviewed.

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The prospects of the Russian economy depend essentially on innovative solutions and are based on new technologies. This has been proved convincingly by various medium-term and long-term forecasts [1–4] and calculations over the previous decades and emphasized again in the Russian President’s keynote speeches [5, 6]. Transition to innovation economy is recognized by the country’s government, scientific, and business communities as the only possible way for Russia’s long-term sustained economic development.

The practical impact of innovative solutions on economic efficiency boosting is attained through investment in reconstruction, modernization, and development projects for launching the output of new products. It is extremely difficult to calculate directly the impact of innovative solutions on the economic performance (e.g. the increase in the gross value added) (such calculations are performed for innovative projects) because of the high dimensionality of the problem and numerous exogenous variables (output scale, prices, and volume of investments required for the implementation of innovative solutions etc.). By the estimates of Russian scientists, intensive factors only account for about 10% of the country’s GDP increase [3]. In the conventional models of long- and medium-term forecasts, innovative solutions are only indirectly recognized through investment indicators. Such calculations fail to evaluate directly the level and scope of innovative solutions, and the investment efficiency is taken into account through several indirect indices such as energy intensity, resource intensity etc.

Innovative projects are known to be the basis of progressive solutions. Their scope and quality determine the investment efficiency level as well as the competitive ability of the Russian economy. The investment saturation with innovative solutions is a complex and costly process requiring the synchronization of contributions from numerous research directions and costs broken into the stages of the innovative cycle. Low-innovation investment projects in a competitive environment can only result in the output of noncompetitive products with a short life cycle.

The lack of demand for innovative solutions in the Russian economy during its movement to the market resulted, on the one hand, in the predominance of extensive growth factors, and on the other hand, in the accumulated information about a number of developed, if unrealized, innovative and investment projects. Those projects were usually developed without a clearly defined order, on the developers’ initiative, they are characterized by their varying maturity level and potential economic effect differs significantly. Transition to innovative economy has considerably boosted the demand for efficient projects. Due to the organization of innovative projects preparation including well-defined customer’s directions to the project developers and allocation of the necessary funds for the project preparation by foundations, venture companies, and commercial banks may lead to large-scale efficient projects of this type. The customer’s function can be performed by the state represented by the relevant ministry (agency). Newly established corporation, holding, company, or a private business can also be a customer.

The great number of projects (100 and more) submitted for the projects customer’s consideration, their diversity and frequent versatility present significant difficulties in their analysis and subsequent selection. Therefore, the project customers are offered a stage by stage approach to the analysis and selection of innovative projects. As often as not, the issue of multidimensionality and the insufficient comparability of various indicators characterizing projects is addressed in a simplified way applying additive or multiplicative convolution of numerous criteria in building a scalar criterion. Thereat the uncertainty and interrelationship of individual indicators is supplanted by subjective expert assessment of “weight” coefficients in the convolution func-
This introduces a significant error, which is in no way reduced as the number of experts increases.

Another, stage by stage, approach would be more preferable when project indicators are compared on the natural basis characteristic of the project implementation process. First the set of reviewed projects is subdivided into ordered subsets in accordance with the specifics of the customer’s technological structure and (or) according to the customer’s preferences with respect to the established criteria. For this purpose, the entire set of presented projects is subdivided into four groups: exploratory (new product concept), innovation (with the prototyping stage completed), innovative investment (prototyping + evaluation of investment in production), and investment projects (investment in production + consumer investment). Innovative projects presented to the customer also differ in the following: the state of the goal-attaining process; positioning with respect to the customer’s package technology; level of competitive ability; patentability level; the project state within the project life cycle (PLC); risk level; economic outcome; information-logical model (ILM) of the decision-making process. Then for the analysis and selection of projects, well-known methods of multicriteria optimization can be successively used in each group (paired comparison, lexicographic ordering, the concession method) or methods of scalar convolution function (additive or multiplicative) (Fig. 1).

The proposed approach is based on the ideas of stage by stage informational saturation of the basic characteristics (descriptor) of the project with reliable data. It involves the successive determination of the project characteristics measured in ordinal scales and building of a stage by stage model of the goal attaining process, i.e. the transition from the initial stage to the final one. Such a stage by stage model has lately been gaining an increasing popularity in describing the process of addressing complex issues in the “roadmap” form.

Fig. 1. Information-logical model of the project state analysis:
1—State of the project goal-attaining process; 2—package technology level; 3—competitive ability; 4—patentability level; 5—project state in the full project life cycle; 6—economic outcome, 7—decision-making ILM.

The foregoing drawbacks can be removed by building a stage by stage ILM for addressing the issue considered within a particular project.

Information-logical model of project analysis.

Despite the sharp drop in the investment and R&D costs accompanying the transition to market economy, many innovative structures have accumulated a considerable data bank on innovation, innovative investment and investment projects. Some of those projects have already lost their competitive advantages, others, on the contrary, assumed even higher market attractiveness.

The evaluation and selection of projects to be financed is significantly complicated by the presence of many criteria that cannot be reduced to a single index, including such as expected income, project implementation time, risk of failure, competitive ability etc.

In order to facilitate the analysis of a large number of projects a stage by stage ILM can be used which on appraising projects takes into account eight earlier presented indicators (see Fig. 1).

The mechanism of decision making in project selection in this case includes three stages: first each project is positioned in ILM framework; then the set M of evaluated projects is subdivided in ordered subset:

$$M = \bigcup_{j=1}^{k} M_j, \quad M_1 > M_2 > \ldots > M_k,$$

where “>” designates the preference of every project from $M_1$ to any project from the subset $M_2$, etc.; then projects from $M_1$ are considered taking into account some economic criterion; then selection from $M_2$ is made etc. up to the exhaustion of the available investment resources.

In some cases the set $M$ can better be subdivided into subsets $M_1^3, M_2^3, \ldots, M_f^3$ depending on the specifics of the customer’s technological structure where every subset includes similar-target projects (e.g., projects intended to work out finite conversion technology). Rules of the set $M$ formation and of its partition into ordered subsets were considered in detail in some Russian publications [8–11].

Building a step by step information-logical model.

The suggested approach to the project selection differs significantly from the rest of those in presenting controlled economic processes from the viewpoint and in the form of packaged technologies.

For the informational representation of technological processes in the production-economic system (PES) the ILM formation rules are applied [8, 9, 11]. The PES [12], depending on the purposes of the analysis, can mean an enterprise, organization, company, corpora-