Effectiveness evaluation of the R&D projects in organizations financed by the budget expenses

D Yakovlev, E Yushkov, A Pryakhin and M Bogatyreova
National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Kashirskoe shosse 31, Moscow, Russia
E-mail: DYYakovlev@mephi.ru

Abstract. The issues of R&D project performance and their prospects are closely concerned with knowledge management. In the initial stages of the project development, it is the quality of the project evaluation that is crucial for the result and generation of future knowledge. Currently there does not exist any common methodology for the evaluation of new R&D financed by the budget. Suffice it to say, the assessment of scientific and technical projects (ST projects) varies greatly depending on the type of customer – government or business structures. An extensive methodological groundwork was formed with respect to orders placed by business structures. It included “an internal administrative order” by the company management for the results of STA intended for its own ST divisions. Regrettfully this is not the case with state orders in the field of STA although the issue requires state regulation and official methodological support. The article is devoted to methodological assessment of scientific and technical effectiveness of studies performed at the expense of budget funds, and suggests a new concept based on the definition of the cost-effectiveness index. Thus, the study reveals it necessary to extend the previous approach to projects of different levels – micro-, meso-, macro projects. The preliminary results of the research show that there must be a common methodological approach to underpin the financing of projects under government contracts within the framework of budget financing and stock financing. This should be developed as general guidelines as well as recommendations that reflect specific sectors of the public sector, various project levels and forms of financing, as well as different stages of project life cycle.

1. Introduction
Knowledge management deals with the task of defining the most valuable knowledge generated in the course of R&D projects implementation. The quality of generated knowledge in the future as well as the competitiveness of will-be specialists depend on how efficiently new projects are assessed. Previous discussions embraced competitive education using advanced network technologies at the NRNU MEPhI [1]. The current study analyses in more detail methodological aspects of evaluating highly promising R&D projects.

Quite recently, this country with its huge and, as it seemed, unlimited reserves of raw material resources, was heavily oriented towards the development of industries associated with the extraction and processing of natural raw materials. However, at present, an increasing implication is the idea of shaping a new economic development model, in which intellectual property is both one of the main catalysts for the processes occurring in the economy and part of the enabling environment for enterprise development, including small innovative business.
It should be borne in mind that the mere existence of intellectual property is a necessary but not sufficient condition for the achievement of goals. The most essential step is the establishment of a sound and workable system of innovation activity support at all key stages, and most importantly – at the stage of testing its effective functioning in practice.

The practice of public R&D funding brought about a demand for the guidance that have been developed and reflected in the activities of state authorities, state financing funds, Russia’s Fund of Technological Development and others. Overall, the findings reveal that no common methodological base has been made available so far – with respect to decision-making procedures on the effectiveness of public funding of scientific-research, scientific-technical and innovative activities (STA).

It turns out that currently there is not any clear notion of R & D rating methodology excepting for separate methods. Methodology assessing the effectiveness of R & D dates back to the Soviet period of the 60-ies - 80-ies. By the end of 80-ies a formal approach had rooted in "the Methodical Recommendations for the Integrated Assessment of the Efficiency of Measures Aimed at Accelerating Scientific and Technical Progress". It was approved by the resolution of the State Committee for Science and Technology and the Presidium of the Academy of Sciences of the USSR of March 3, 1988, N 60/52 [2]. The early 90-ies were marked by a sharp decrease in scientific research on this issue. The only guidelines "Methodological Recommendations on the Evaluation of Investment Projects Efficiency" (1999) [3], as the name suggests, were not focused on STA distinctive features.

Suffice it to say, the assessment of scientific and technical projects (ST projects) varies greatly depending on the type of customer – government or business structures. An extensive methodological groundwork was formed with respect to orders placed by business structures. It included "an internal administrative order" by the company management for the results of STA intended for its own ST divisions. Regretfully this is not the case with state orders in the field of STA although the issue requires state regulation and official methodological support.

2. Evaluation of projects in accordance with the methodology of the State Committee on Higher Education in Russia

The methodology developed in 1996 was adapted to assess the quality of scientific and technical projects according to the materials of business plans [4]. The indicators of the project are divided into four groups:

• scientific and technical;
• organizational and those of production;
• market-based;
• economic.

A number of scientific and technical indicators included:

• direction of development;
• scientific and technical level of development;
• scientific and technical potential of the team;
• legal protection.

Each indicator involved two levels and scoring of these levels (5 and 1 point).

With respect to the indicator "direction of development", we can see that following from the description is nothing else but the scale of the scientific and technical problem solved. In fact, two levels of the indicator are proposed:

• Scientific and technical production (STP) is a technical tool at the system level. Therefore, it is not just the improvement of STP properties that counts, but also the change in the basic structure, functional principle (5 points).
• STP is a technical tool at the system item level. The existing properties are retained (1 point).

In our opinion, it is essential to replace the name of the indicator by "scale development" and to expand the number of levels, at least up to three, and even better – five. Listing two levels is evidently insufficient.
As for the indicator "scientific and technical level of development", here the authors simplified the real state of things by only taking into account two levels:

• the STP being created is substantially different from products of similar purpose in Russia;
• the STP being created is substantially different from products of similar purpose abroad.

In general, this methodology does not fully meet necessary requirements due to the lack of novelty, non-obviousness, a differentiated approach to the properties of the projects concerning their scale and technical level.

3. Methodology developed within the framework of Russia’s Program of Economic Research

The methodology originates from economic research and suggests the following set of features underlying the choice of projects:

• the importance of the project for solving urgent problems of national economy;
• the clarity of problem statement;
• the use of modern scientific methodology, the detail and originality of the method of study;
• the availability of the necessary data, the degree of their objectivity;
• applicants’ experience and their acquaintance with scientific work in the relevant field;
• realism and effectiveness of the project design;
• a certain level of the project presentation;
• performers’ professional growth promotion [5].

Thus, the list has two new characteristic features:

• The first sign is “the clarity of the problem statement”, which describes the application in terms of the quality of expressing its content.
• The second sign is "sustaining performers’ professional growth"; it points to the existence of a special kind of scientific studies effect – an educational one, which has been conventionally neglected in Russia’s practice of research funding, as compared to foreign practice.

4. Methodology developed within the framework of Russia’s Foundation for Basic Research (RFBR)

This methodology involves a multi-stage examination and the rating of projects [6]. The first level is a preliminary review of the project, where the following tasks are accomplished:

• Selecting projects for the second level of expertise.
• Preparing motivated conclusions for rejected projects.

However, it is not quite clear, what criteria serve the basis for the rejection of projects on the first level. On the second level the expertise determines the overall rating of the project (OR):

\[ OR = R_1 + R_2 + R_3 \]  

where \( R_1 \) is the rating of the scientific value of the project, \( R_2 \) is the rating of the feasibility of project execution on time, \( R_3 \) is the rating, correcting the total value of the two previous ratings.

The first rating assesses whether the implementation of the project is to:

• lead to new fundamental results;
• ensure significant progress in this area;
• exercise impact on progress in this or related scientific field (for example, grade "2" means "sufficient usefulness of the project, grade "5" is a request for an outstanding result).

The second rating takes into account the following:

• scientific level of the chief of the staff;
• potential of the team headed by him;
• scientific contribution and publications on the topic;
• information, laboratory and material security of the project;
• correctness of task distribution over stages, results and terms of work.

The overall ranking value OR can take values from points 2 to 13.
In fact, when creating this method, the authors relied significantly on the practical experience of functioning funds for financing research rather than scientific theory. It appears that the major drawback of the methodology is that it does not explicit such a property as the scope of the problem. In addition, it is difficult to speak about the universal character of the given system. Universality could have been tackled upon in case of an expert assessment that allows correlating the rating of the project and the cost for its funding in the form of a function: “cost – scientific effect.” However, the range of funding for projects in the RFBR system is not great.

Doubtful as it might seem is the criterion of “a number of publications on the research topic” even with the prestige edition. In fact, the inclusion of the researcher in a new direction is in parallel with generating new ideas that have not yet manifested in published works. That is why the approach adopted in the RFBR system creates benefits to researchers continuously operating in the appropriate direction, as the trend of "diminishing returns" comes into being. Thus, the criterion of publications on the topic prevents researchers from switching over to new directions, because it appears to be no easy matter to get a state support for such projects.

The literature on the issue is extensive. A good idea of research projects assessment is given in an overview by M. Gibbons & L. Georghiou in Evaluation of research. P.: OECD. A selection of current practices (1987) [7], as well as in the studies from IMEMO RAN A.A. Dynkin and others.

In 1967, the United States approved the criteria for research project evaluation in relation to the needs of the National Science Foundation (NSF), which were specified further. In the first place, there are such indicators as:

- the scientific value of the proposed research;
- the possibility of its implementation by a separate scientist or a team of researchers.

This takes into account the following:

- the likelihood that the study will lead to important discoveries or significant conceptual generalizations in the field of science and their dissemination to other areas;
- the ability of a scientist to carry out an investigation, given his academic achievements, experience, education, capabilities, alternative approaches to the problem;
- the ability of the organization where the scientist is affiliated to provide the required conditions for project implementation;
- the practical value of the research results to national goals (the likelihood that the study could become the basis for new inventions or improved technologies);
- the role of the project in solving social problems;
- the role of the project in strengthening the scientific potential of the country, educational and scientific level of the personnel.

Of interest is the criteria system of research projects used in the US Ministry of Defense (Naval Research Department), with a ten-point scale evaluating a number of factors:

- the quality of the study – the importance of the problem, its uniqueness, the degree of fundamentality as compared to the achieved level of knowledge in this area;
- the quality of the scientific staff (a number and quality of principal investigators’ publications, rewards, acquired experience, etc.);
- the degree of compliance of the resources with the objectives, the degree of innovation and operability of technical facilities, etc.;
- the need for resources necessary to accomplish the project;
- a potential impact of the project on satisfying the needs of the Department in new technology, research and operations.

The study, conducted by the Organization for Economic Cooperation and Development (OECD), examined the evaluation criteria for the selection of research projects in the member of countries of the above mentioned international organization. The classification of evaluation criteria of the projects makes up three groups.

The first group comprises the criteria for the scientific value of the project:

- compliance of the scientist’s competence level with the project requirements;
- value of the work for the relevant field of science (originality);
The second group is valid for the compliance of required resources with the assigned scientific task.

The third group is concerned with the impact of the project on reaching economic and social goals.

The analysis of domestic and foreign data on this issue shows that the methodology for project evaluation in R & D (contract and budget-based) must satisfy the following requirements:

- be scientifically sound;
- ensure "absolute" assessment to determine the feasibility of the project;
- be universal (applicable to projects of different scale, different social orientation, funded by using a variety of institutional forms (state contract, estimate and budget, stock grant, venture capital) at different stages of the life cycle of the project;
- have a quantitative nature;
- the complexity and intensity of the system must be justified (experts’ participation in the evaluation process is costly);
- be informationally efficient (is to ensure the complete utilization of available information both directly and indirectly characterizing the project, to mobilize information, which is owned by the initiator of the project);
- possess full characteristics of the projects;
- take into account the differences in value of different effects and costs;
- take into account the specifics of public-oriented projects (the difficulty of comparing the types of effect, cost and inevitability of the expert-scoring approach).

No doubt, the existing methodological approaches bring us to the conclusion that they do not satisfy the given requirements as they:

- do not have satisfactory scientific justification;
- are not absolute, but are of locally-comparative nature;
- are far from universality;
- their simplicity is not justified;
- do not use all available information about the project (in particular the assessment of a potential project implementer);
- fail to give a full description of the projects (the scope of the project is omitted).

5. The concept of the proposed methodology

A new method of evaluating project implementation by determining the index of cost-effectiveness (IEC), which is the ratio of budgeted cost-effectiveness of the project (BEC) for regulatory cost-effectiveness (NEC) is proposed.

\[
IEC = \frac{BEC}{NEC}
\]

(2)

where budget cost-effectiveness (BEC) is the ratio of the budget effect of the project (BEP), expressed in points to the cost of the project (the CP) (in millions of rubles):

\[
BEC = \frac{BEP}{CP}
\]

(3)

Regulatory efficiency project (NEC) is a minimum acceptable ratio of the budgetary effect of BEP (min) expected from the implementation of the project, expressed in points, to the cost of the project (one million rubles):

\[
NEC = \frac{BEP \text{ (min)}}{CP}
\]

(4)

The condition of acceptance of the project financing is:

\[
1 < IEC
\]

(5)
The higher the IEC score, the more the project is perspective for the funding. Therefore, the valuation is assumed to be based on the following criteria:

- novelty;
- the scale of the problem being solved;
- scientific and technical level;
- scientific and technical potential;
- executor’s potential (intellectual);
- executor’s potential (level of experience);
- technical base;
- information base;
- target criteria (relevance of the objectives targeted by the project and the project's contribution to their achievement);
- competitiveness of results;
- planned period of use of the results (takes into account the period of their obsolescence);
- positive / negative side effects of the project implementation (environmental, social, connected with the state security, etc.);
- quality of feasibility studies;
- the assessment made by the executor of the project and the level of trust in them;
- risks associated with the project.

Normally the sum of scores corresponds to the cost of the project. This means that points are getting value. For example, if you set the standard of 100 points on one million rubles, it means that 100 points is equivalent to one million rubles, and 1 point – to 10 thousand in ruble terms. The project cost of two million rubles should ensure the effect, which is not less than 200 points. Accordingly, the project cost in 500 thousand ruble needs to ensure the effect of 50 points.

Thus, the study reveals it necessary to extend the previous approach to projects of different levels – micro-, meso-, macro projects. The preliminary results of the research show that there must be a common methodological approach to underpin the financing of projects under government contracts within the framework of budget financing and stock financing. This should be developed as general guidelines as well as recommendations that reflect specific sectors of the public sector, various project levels and forms of financing, as well as different stages of project life cycle.

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