Organizational and economic polystructure of innovative projects implementation

Организационно-экономическая полиструктура реализации инновационных проектов
Estructura organizativa y económica en la ejecución de proyectos innovadores
Estrutura organizacional e econômica da execuçao de projetos inovadores

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Abstract

The procedure of organizing, holding tenders and reviewing projects is a formal process, based on expert evaluation, which does not consider the peculiarities of high-tech projects, especially in terms of obtaining possible intermediate results. It has a high degree of uncertainty about the final product from the standpoint of its consumer and functional parameters, which causes a high degree of probability of making suboptimal decisions.

The solution of the above problem proposed in this article is to form a specialized organizational and executive structure of the project implementation within the framework of the system integration of the participants or executors of the project.

This article proposes a more politically correct system legitimacy in the framework of existing legislation, because the previous one had a lack of selection procedure of the implementation of high technology projects.

Keywords: commercialization, competitive selection, contract system, organizational and executive polystructure of the project, scientific and technical project.

Аннотация

Процедура организации, проведения конкурсов, рассмотрения проектов носит зачастую формальный характер, основанный в значительной степени на экспертной оценке, не учитывающий особенности высокотехнологических проектов, прежде всего в части получения возможных промежуточных результатов, высокую степень неопределенности по конечному продукту с позиций его потребительских и функциональных параметров, что обусловливает высокую степень вероятности принятия неоптимальных решений.

Предлагаемое в данной статье решение вышеуказанной проблемы заключается в формировании специализированной организационно – исполнительской полиструктуры реализации проекта в рамках системной интеграции участников – исполнителей работ по проекту.

Разработан инструментарий, представленный процедурой и экономико-математическим аппаратом объективизации процессов реализации наукоемких проектов с позиций их стратегической ориентированности и одновременно потребительской результативности.

В отличие от существующей недостаточно представительной однокритериальной процедуры отбора и контроля за реализацией наукоемких проектов, предложена более корректная поликритериальная система,

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лигитимная в рамках существующего законодательства.

Ключевые слова: коммерциализация, конкурсный отбор, контрактная система, научно-технический проект, организационно – исполнительская полиструктура проекта.

Resumo

O procedimento de organizar, fazer ofertas e revisar projetos é um processo formal, baseado na avaliação de especialistas, que não considera as peculiaridades de projetos de alta tecnologia, especialmente em termos de obtenção de possíveis resultados intermediários. Tem um alto grau de incerteza sobre o produto final do ponto de vista de seus parâmetros funcionais e de consumo, o que causa um alto grau de probabilidade de tomar decisões sub-ótimas.

A solução para o problema anterior proposto neste artigo é formar uma estrutura organizacional e executiva especializada para a implementação do projeto no âmbito de um sistema de integração dos participantes ou executores do projeto.

Este artigo propõe um sistema de legitimidade mais politicamente correto no âmbito da legislação existente, uma vez que o anterior não dispunha de um procedimento de seleção para a implementação de projetos de alta tecnologia.

Palavras-chave: comercialização, seleção competitiva, sistema de contratos, estrutura organizacional e executiva do projeto, projeto científico e técnico.

Resumen

El procedimiento de organización, realización de ofertas y revisión de proyectos es un proceso formal, basado en la evaluación de expertos, que no considera las peculiaridades de los proyectos de alta tecnología, especialmente en términos de obtener posibles resultados intermedios. Tiene un alto grado de incertidumbre sobre el producto final desde el punto de vista de sus parámetros funcionales y de consumo, lo que causa un alto grado de probabilidad de tomar decisiones subóptimas.

La solución al problema anterior propuesto en este artículo es formar una estructura organizativa y ejecutiva especializada de la implementación del proyecto en el marco de un sistema de integración de los participantes o ejecutores del proyecto.

Este artículo propone un sistema de legitimidad más políticamente correcto en el marco de la legislación existente, ya que el anterior carecía de un procedimiento de selección de implementación de proyectos de alta tecnología.

Palabras clave: comercialización, selección competitiva, sistema de contratación, poliestructura organizativa y ejecutiva del proyecto, proyecto científico y técnico.

Introduction

One of the most effective conceptual ways of development of the Russian scientific and technological complex as a selected enterprise of the domestic industry is the Federal financing of science-intensive projects selected by the Federal authorities on a competitive basis, primarily through the system of state order.

At the same time, the public administration system performs mainly financing and regulatory functions.

Subject-oriented management of the relevant complex is carried out by two categories of subjects of management: public administration and management of enterprises-contestants. Both are interested in the high level of validity of

applications and in the high quality of their ranking, which ultimately leads to the selection of the most effective projects.

The complexity of the consideration of the problem caused the multi-aspect theoretical directions of this study. Thus, coordination of strategic development of the various sectors and spheres of economy, including state regulation in modern conditions, is dedicated to the scientific writings of authors such as Glazyev, S. Yu., Gryaznova, A. G., Gurov, I. P., Dumnova, T. G., Dynkin, A. A., Kochetov, E. G., Kuzyk, B. N., Kushlin, V. I., Milner, B. Z., Raizberg, B. A., Sukharev, O. S., Yakovets, Y. V., Yasin, E. G., and some others. We can find a lot of works which include a significant contribution in the field of forecasting, planning and management of innovative development of both businesses and state regulation of innovative activities, commercialization of innovations, mechanisms of trust management by objects of high complexity and importance. However, the problems of complex system integration of strategic aspects of macro-innovative development of the economy with the design and program level of its specific implementation, accounting and coordination of strategic interests of the state, business and society as statistics shows are still unresolved: there is an extremely inefficient contribution of implemented innovative projects in the development of the economy of the Russian Federation.

To solve the above problem, we formed a specialized polystructure of the project implementation and developed the tools. The article suggested a more appropriate system.

Methodology

Experience in the creation of aviation and rocket and space technology at all stages of the life cycle indicates the need for the formation of a specialized sustainable highly competent organizational and executive structure at the earliest stages of development of the equipment samples connected with formation of the scientific and technical reserve and performance of research, developmental and technological works (R & D) consolidating a set of the effective performers selected generally on the ground both in country and geo-economic space, because the enterprises of high-tech industries quite often choose the foreign contractors possessing a wide set of qualitative production, the ability to perform unique works (services). There are a number of examples confirming that in the conditions of the laws of modern deepening of

specialization and international division of labor, foreign suppliers are able to supply similar products at lower costs than national, as well as better quality products (Novikov, 2018).

It is very important for the customer enterprise to detail its requirements to the potential contractor and to disclose the indicators (criteria) of their performance. Only in this case the strategies (solutions) of suppliers, optimal from their point of view, will be objectively evaluated by the customer and will be effective for him. In countries with a developed market economy, the civilized market of state orders is the result of long-term evolutionary development (Dmitriev & Novikov, 2017). In Russia the market of state orders is still being formed. The development of this market involves, first of all, the reform of the institutional system in the field of budget procurement, including the rules and mechanisms for placing orders, concluding contracts and control procedures (Novikov, 2014).

Another disadvantage of the management of competitive selection of high-tech projects is that it does not allow the customer without a detailed decomposition of the developed product, a clear breakdown of the requirements for the components of the product and the qualification of performers to organize competitive procedures as to ensure optimal cooperation in the implementation of complex science-intensive projects, as well as the commercialization of all possible commodity outputs of the project (Novikov & Tikhonov, 2016). Entering the competition of suppliers with strategies involving cooperation of a lower level with higher private indicators will significantly improve the quality of the selected applicants for the development and supply of high-tech products (Kanaschenkov, Matveev, Minaev & Novikov, 2017).

Analysis of research in the field of improving the procurement activities of high-tech industrial enterprise indicates a lack of systematic study of the following issues:

- ensuring the objectives and requirements for procurement activities;
- considering the specifics of the life cycle of creating complex samples of high-tech products to improve the organizational and methodological support of competitive procurement procedures;
- development and implementation of specific practical measures to improve the

selection of executors of scientific and technical projects.

These problems take place also in large industrial corporations (Kanaschenkov, Kanaschenkov & Novikov, 2016).

Formation of a specialized polystructure

The proposed solution to the problem within the framework of the system integration of participants and executors of the project is the formation of a specialized organizational and executive polystructure.

The organizational and executive polystructural project is understood as a set of participants and executors of the project adopted for implementation in the form of separate specialized structural entities that meet the

qualification and competence requirements in accordance with the goals and strategies of the project (Novikov, 2018). This set of elements functions in a relationship as a single system, performing specific objectives at each stage of the project life cycle (Kraev, Tikhonov & Novikov, 2018).

The purpose of the political structure is the effective implementation of the scientific and technical project, commercialization of its results at various stages of the life cycle with the minimum possible risk of scientific and technical failures. One of the main assumptions of the proposed approach is the need to commercialize the so-called intermediate and by-products (spin-off) of the project, obtained on the basis of the created scientific and technical reserves, the inclusion in the consideration of the concept of the total product of the project (Figure 1).
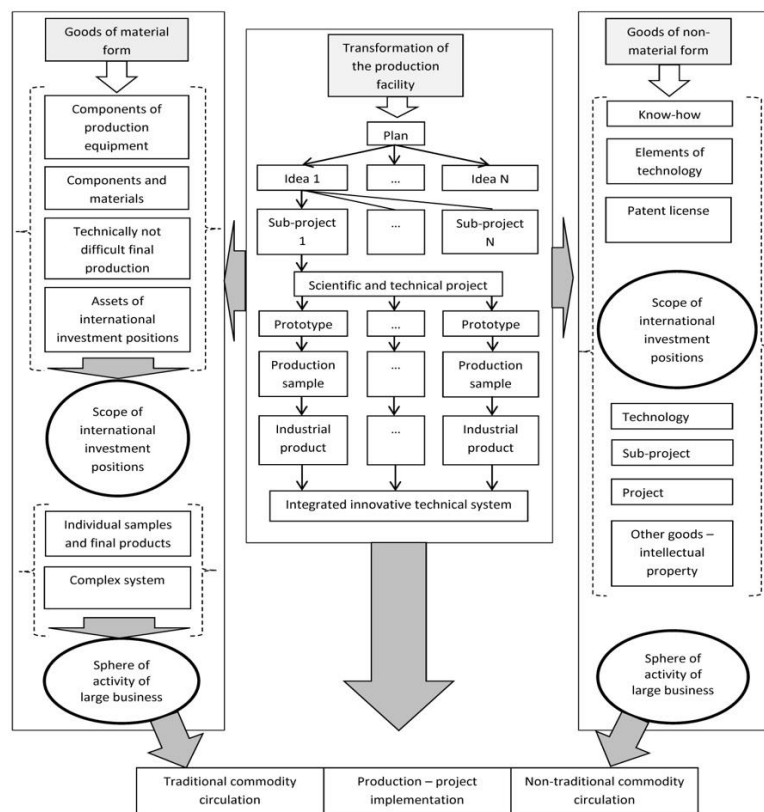

Figure 1. Types of intermediate, by-product and final product forms of the Project

To consider the substance of the proposed decision, we introduce the following:

Dz (Bz) is a total probable income from the implementation of scientific and technical reserves z (z = 1,…,Z), taking with probability Bz the form of goods:

$$D_z(B_z) = \sum_t \left[D_{zI}(t; B_z) + D_{zII}(t; B_z) + D_{zIII}(t; B_z) \right]$$

,

if D z I (t; Bz); D z II (t; Bz); D z III (t; Bz) is a probable income from the implementation of scientific and technical reserves z (z = 1, …, Z), receiving with probability Bz form of goods in

periods t, the corresponding I, II and III risk areas of the project (Figure 2).

Yz (Rz) is a total probable detriment of the project from the scientific and technical risks or the possible risks (Rz) of scientific and technical pitfalls of creating a backlog in the planned time frame and in accordance with the requirements of the customer, expressed in monetary terms:

$$Y_z(R_z) = \sum_t \left[Y_{zI}(t; R_z) + Y_{zII}(t; R_z) + Y_{zIII}(t; R_z) \right]$$

,

if Y z I (t; Rz) ; Y z II (t; Rz); Y z III (t; Rz) is the probable damage on the project from scientific and technical risks (Rz) at creation of scientific and technical reserve in the periods t corresponding to I, II and III risk zones expressed in monetary equivalent (Novikov & Dmitriev, 2018).

Characteristics of risk zones in the coordinates of the accepted designations will be as follows:

for zone I:
$$\sum D_{zI}(t; B_z) < \sum Y_{zI}(t; R_z)$$;

for zone II:
$$\sum D_{zII}(t; B_z) < \sum Y_{zII}(t; R_z)$$;

for zone III:
$$\sum D_{zIII}(t; B_z) < \sum Y_{zIII}(t; R_z)$$.

Herewith:
$$B_{zI} < B_{zII} < B_{zIII}$$;
$$R_{zI} > R_{zII} > R_{zIII}$$.

Economic and mathematical modeling

Next, we will conduct economic and mathematical modeling using the method of linear programming that implements the formulation of problems by Boolean variables.

Economic and mathematical model of optimization of organizational and production structure of the project is formulated as follows.

Let the result of the pre-investment phase of the project life cycle is the decision to implement it with the following basic parameters:

- F lim is the total project costs in monetary terms;
- T lim is the valid lifetime of the project in years;
- Ki is the given level of innovative quality of development;

Rz is the set level of probable risks of scientific and technical failures of creation of scientific and technical reserve in the planned terms according to requirements of the customer (Dmitriev & Novikov, 2018).
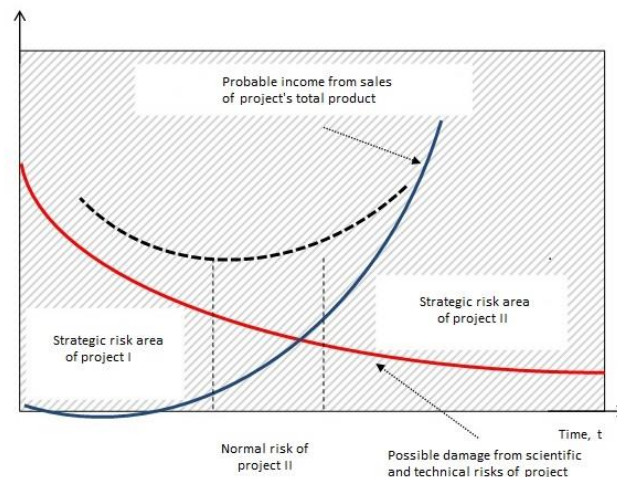

Figure 2. Changing the parameters of the implementation of the results scientific and technical project at various stages of the life cycle

It is necessary to form an optimal organizational and executive polystructure of the project implementation, consisting of a variety of industry, corporate and other centers of technological competence operating in the economic space of the territory (country) and a variety of centers of technological competence operating in the economic space of the organizational and economic system of a higher geo-economic level (foreign countries), which

will ensure the achievement of the maximum value of the following functions:

$$f(x) = \left[\sum_{t=1} f_I(x_i) + \sum_{j=1} f_{II}(x_j) + \sum_{S=1} f_{III}(x_s)\right] \Rightarrow \max \quad ; \quad (1)$$

If $\sum_{i=1} f_I(x_i) = \sum_{i=1}(d_i \times x_i) - \sum_{i=1}(y_i \times x_i) \quad ; \quad (2)$

if di is a probable income from the possible commercialization of scientific and technical reserves offered by the i–th contractor in the implementation of project work in the strategic risk zone (zone I). The executors are the centers of technological competences of the i–th type (i = 1,..,I) for the zone of strategic risks of the project it is proposed to consider high-tech organizations belonging to the strategic core of the Russian economy, which should own the property rights to the results of development;

yi is a damage from technical and scientific risks in creation of scientific and technological potential of the i–th contractor in the course of work in the area of strategic risks of the project, expressed in monetary terms;

x *i* are the centers of technological competence (CTC) of the i–th type belonging to the strategic core M1:

$$x_i \in M_1\{CTC_i\} \quad ; \quad (3)$$

$\sum_{j=1} f\mathrm{II}(xj)$ и $\sum_{i=S} f\mathrm{III}(xs)$ - functions defined similarly to formula (2) for zones II and III.

At the same time, as executors of xj implementation of the project works in the zone of normal risks (zone II), a set of centers of technological competence of the j– th type (j = 1,..,J), owned by world leaders in their respective fields. They take part in polystructure of project as outsourcing companies:

$$x_j \in M_2\{CTC_j\} \quad . \quad (4)$$

When performing work on the project in the zone of strategic income (zone III) as the executors of the xs is considered a set of centers of technological competence of the s–th type (s=1,..,S), belonging to the strategic core and (or) other organizational entities of the polygon (Figure 3) specially created for effective implementation of marketing and sales functions, including functions for after-sales service of the designed equipment:

$$x_s \in M3\{CTC_s\} \quad (5)$$

with the following restrictions:

1) $\sum_{ijs=1}^{ijs} \sum_{i=1}^{i}(c_i x_i) + \sum_{j=1}^{j}(c_j x_j)$
$+ \sum_{s=1}^{s}(c_s x_s) \leq$ F lim; (6)

2) $\sum_{ijs=1}^{ijs} \sum_{i=1}^{i}(t_i x_i) + \sum_{j=1}^{j}(t_j x_j)$
$+ \sum_{s=1}^{s}(t_s x_s) \leq$ T lim; (7)

3) $\sum_{ijs=1}^{ijs} \sum_{i=1}^{i}(k_i x_i) + \sum_{j=1}^{j}(k_j x_j)$
$+ \sum_{s=1}^{s}(k_s k_s) \geq$ Ki; (8)

4) $\sum_{ijs=1}^{ijs} \sum_{i=1}^{i}(r_i x_i) + \sum_{j=1}^{j}(r_j x_j)$
$+ \sum_{s=1}^{s}(r_s r_s) \leq$ Rz; (9)

5) $x_{i(jS)} = \begin{cases} 1, & \text{if } CTC_{i(jS)} \text{ accepted into the formed derivation polystructure;} \\ \\ 0, & \text{if } CTC_{i(jS)} \text{ is rejected as part of the polystructure formation;} \end{cases}$

if c*i(js)* is a cost of project work proposed by i–th (js-th) participants from CTC under review;

ti(js) is a project execution time, duration of the operational and production cycle proposed by the i–th (js-th) participants from the CTC under consideration;

ki(js) is an integral coefficient of innovation quality of scientific and technological potential offered by i-th (js-th) the participants considered CTC;

ri(js) is a risk assessment of scientific and technical failures of the scientific and technical reserve creation in the planned terms in accordance with the requirements of the customer for the i–th (js-th) participants from the CTC under consideration.

The proposed model of formation of the organizational and Executive structure of the project is based on criteria that consider additional revenues from the project, possible from the implementation of side and intermediate commodity outputs in the creation of scientific and technical reserves, and thus, ceteris paribus complements the economy of the project, reduces the risks in the event of possible losses (Tikhonov & Novikov, 2015).

At the same time, the optimal choice of the most effective executors of project works from among the possible at all stages of the project life cycle is provided.
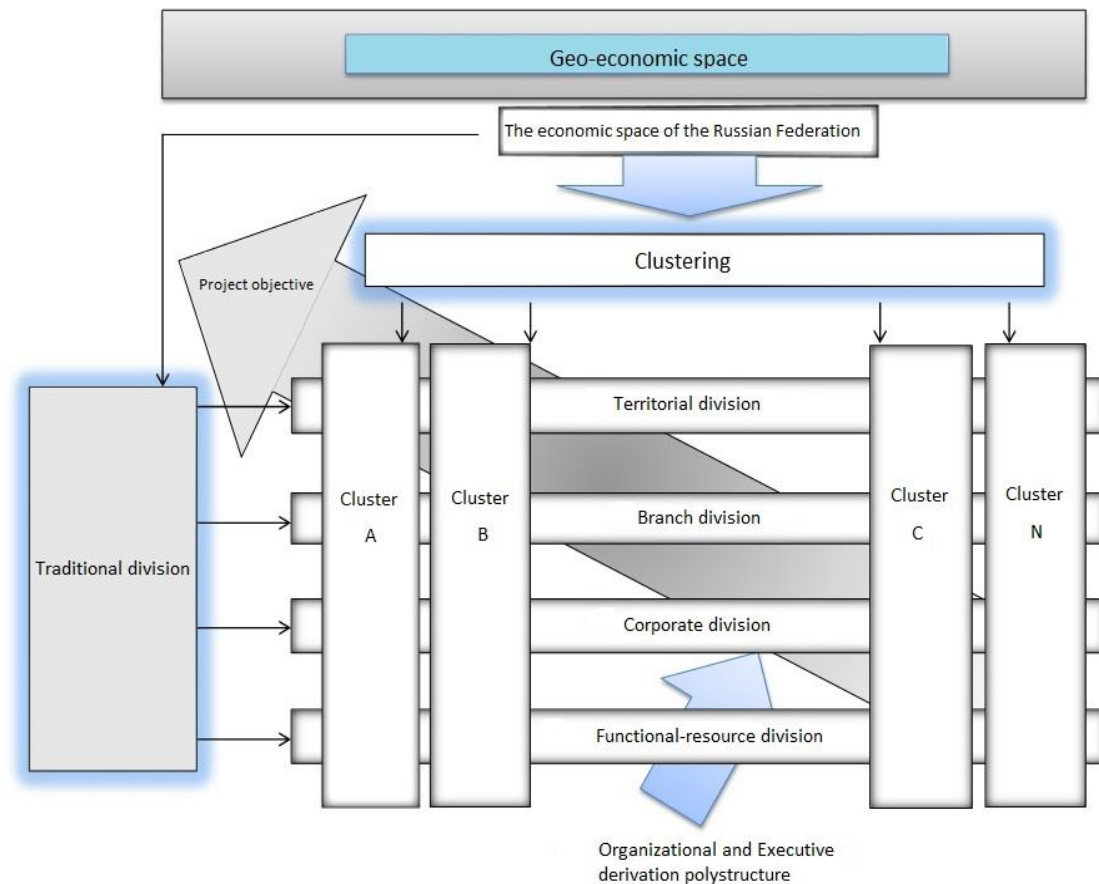

Figure 3. Polygon of selection of potential participants of the formed project polystructure

In accordance with the proposed approach, the life cycle of the project is considered from the standpoint of strategic losses and strategic revenues. At the same time, there are three zones: the zone of increased strategic risks, the zone of normal risks and the zone of strategic revenues of the project. Such structuring allows to lay in not only the requirements of economic nature, but also the conditions imposed on the qualitative structure of its possible solutions: the identity of the contractors to the number of structures and strategic core (Novikov, 2018), auxiliary marketing and sales organizations of the Russian economy or to the number of outsourcing structures from the world centers of technological competence (Novikov & Veas Iniesta, 2018).

Results

In the work, the tools presented by the economic and mathematical apparatus of objectification of the processes of implementation from the standpoint of their strategic orientation and at the same time consumer efficiency were developed. The problem was solved by the formation of a specialized organizational and executive structure of the project. We also conducted economic and mathematical modeling using the method of linear programming, implementing the formulation of problems by Boolean variables, which allowed to form the optimal organizational and executive structure of the project, consisting of a variety of industry, corporate and other centers of technological competence.

Conclusions

Organizational and performance procedures for the implementation of large-scale scientific and technical projects are the main stumbling block on the way to the implementation of strategic plans for the development of Russia.

The existing scientific, practical and regulatory mechanisms for the selection of participants - executors of the project do not implement a

systematic approach and do not ensure the effective achievement of the ultimate goal of the project, reducing its real competitiveness as a result of obsolescence, non-use of opportunities for additional revenues for the project (Pinkovtskaia, Balynin, Arbeláez Campillo, & Rojas-Bahamón, 2019).

Proposals for the formation of the organizational and executive polystructure of the project, based on the criteria of competence, efficiency and taking into account the possible costs and results from the implementation of by-products of the project, compliance with safety and efficiency guarantees in the implementation of the import substitution policy, will allow to perform work on the project at the lowest cost, qualitatively and within the deadlines set by the plans.

Accordingly, first of all, the following categories of management personnel have an interest in introducing managerial innovations in the field of organizational and economic decisions of this kind:

- the introduction of an additional criterion for the consumer assessment of the total product of the project to achieve the maximum reduction in the payback period of public investment through the implementation of all possible commodity outputs;
- directorate of enterprises of scientific and technological complex of Russia in terms of the requirements of the constituent documents;
- participants of enterprises of scientific and technological complex of Russia for the successful implementation of the state contract;
- contractors of enterprises of scientific and technological complex of Russia to meet the requirements of private technical specifications;
- companies that monitor the implementation of relevant projects, for a more comprehensive and productive accounting of the fulfillment of contractual obligations for the commercialization of intellectual property.

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