Conceptual modelling of public administration the innovation process in the context of digitalization with catch-up modernization

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Abstract. The article is devoted to the conceptual modelling of state management of the innovation process in modern conditions. The construction of the conceptual model included the identification and operational description of the goals of state management of the innovation process, the definition of significant controlled inputs to this process from the state, as well as possible types and tools of control actions on them. The article substantiates the roles of the following key parameters of the state impact model on the innovation process: the national innovation resource, the institutional, legal, economic, socio-psychological conditions for its formation, and the state order for socially significant innovations. It is shown that the main and most effective control actions of the social state on the innovation process should be aimed at reducing the cost and providing wide access to modern forms of education at all levels based on digitalization and artificial intelligence. The author substantiates the need for a closer link between the formation of scientific and technological schools of the country and the specifics of its natural resource base, as well as the institutionalization of economic responsibility of experts with state funding of socially significant innovations. The presentation of this conceptual model can become a material for discussion, which will facilitate the transition from conceptual to numerical and simulation modelling of the process under consideration. The article was prepared based on the results of research carried out at the expense of budgetary funds on the state order of the Financial University

1. Statement of the problem and its features

The modern world is characterized by the accelerated development of culture, which leads to the awareness of governments and peoples of new risks and threats to the public good, as well as new opportunities to overcome them. There is a growing understanding that the combination of social stability and sustainable development, the ability to withstand natural and technogen risks and threats, while ensuring a decent life for all members of society is most fully available only to States that have embarked on the path of innovative development. The world experience of the last hundred and fifty years irrefutably shows that the economic, military-political (“hard power”) and cultural-ideological capabilities (“soft power”) of modern States are determined not only and not so much by the scale of the sovereign territory and population. They depend mainly on the economic, political and cultural conditions built by the creative efforts of the people for a healthy and comfortable life, which are an
attractive example to follow. Of course, to the extent that this is possible with the integrity of the global geosystem, differences in the level of development of States and limited international environmental cooperation. Thus, today, the human resource and its key component – the innovation resource - become the main resources for the social development of successful states.

Russia for the past two centuries has been a political subject of catch-up, discreet and incomplete modernization. It is catching up, because it entered the path of modernization later than the pioneers of industrialization did. It is discreet, because a century-long process of “natural” market modernization was interrupted by the World War I and subsequent cruel political and economic transformations. It was resumed for 60 years on a new state-planned basis with a focus on defense and political tasks. It is incomplete because modern Russia is again looking for its way to restore its partially lost positions in the new market conditions and return to a compact, although noticeably expanded over the past half-century, number of leaders of innovative development.

In this regard, the issues of the possibility, content, goals, directions and boundaries of state management of the national innovation process in modern conditions become particularly relevant, since despite the naturalness of cultural and innovative processes, as shown by the best world practices, the social state can, and therefore should, promote innovative development. At the same time, excessive dirigisme can distort and, thus, slow down the economy’s entry into advanced innovative positions. We need a conceptual model to find systemic answers to these questions.

2. Conceptual model of state management of the national innovation process in Russia in modern conditions

By a conceptual model, we mean a system of interrelated concepts of a specific subject area that allows us to describe and explain facts, phenomena, and processes in this area, and, depending on the level of completeness and adequacy of the model, to anticipate and manage changes. To construct a conceptual model of innovation process management, we should reveal the content of the process system, the innovative process at all levels from private, to national, and global as a multi-contour self-managed and managed system, its features and differences from other economic and socio-cultural processes, actors of this process, including the state, and their functions and goals. Let us consider the conceptual apparatus of our subject area.

The concept of four types of systems, related to space-time limitations has developed, in economic (and more broadly, social) systematic research (G. B. Kleiner, [1]): object, project, process and environmental ones. Process systems are not limited in space and can fill all the space available to the process, but they are limited in time and stop when they have exhausted their spatial or material-energy resource. Innovation processes at the level of an individual innovation or cluster of innovations are process-type systems. National and global innovative processes, representing a network of successive processes that unfolds over time, are similar to environment-type systems, since they are not limited both in environment and in time.

Unlike object systems, which are described by means of object components and relationships, and project systems, which are described by means of works and events, process systems have not yet found a generally accepted description. Semantic kernel analysis of process systems, that includes such components as “activity”, “action”, “status”, “subject of activity”, “object of activity”, “purpose of activity”, “resources”, “inputs”, “outputs”, “value”, and “clients”, allows us to give the following detailed definition of process systems, based on three basic concepts of “action”, “resource” and “state”. The process system is the system of the subject of activity actions to transform the object of activity in accordance with his purpose. This assumes the appropriate conditions of the object are met, that occur (find out) as the appropriate states (parameters) of this object. The result of it is an action corresponding to the subject’s goal that goes beyond the process system and has value for the subject of activity and/or others clients. By action we mean an elementary component of the process system, which represents the time-taking transformation of incoming resources into outgoing ones, carried out by the subject of activity in accordance with his target and volitional settings. We understand resources as the necessary conditions to implement individual actions, activities and processes (process systems) as a whole. As
for the state, it means such characteristics of the system and its resources that make it possible to perform a particular action.

An innovative process (IP) of any level combines the actions of many actors, individual and institutional, who perform actions and provide their resources, without which the IP could not occur or, at least, could not have been implemented the best possible way. However, the overall result of IP is determined to the greatest extent by the innovators themselves, that is, those who are able to see the ideal image of the future, find and implement the best ways to bridge the gaps between the desired and the existing. They are the bearers of the personal Innovative resource (IR), which forms the IR of businesses and the national IR, which, in our opinion, is one of the most important objects of the national IP governance.

IR as a relatively new object of systemic research of IP has connections, similarities and differences with such more researched concepts as human capital (HC) [2] and vital resources (VR) [3] and can be defined through these connections. An individual’s HC is usually viewed as a productive economic asset or investment project with its own capital costs (for upbringing, education, etc. in the pre-active period), current costs and income (expenses for personal and family consumption and economic income during the period of economic activity) and supporting costs (in the post-active period). The economic success of an individual can be assessed by the same indicators (net present value – NPV, internal rate of return – IRR, profitability index – PI, payback period – PBP, discounted payback period – DPP), as the economic efficiency of an investment project. Since HC is additive with regard to investments, costs, income and NPV, the HC of a business and the national HC can be obtained by summing the individual ones.

The concept of VR, which came from sociology, does not yet have generally accepted definitions. It seems to be useful for a system understanding of the innovative resource and the possibilities of their governance. We can offer the following working definition: VR is a system of innate (genetically and ontogenetically determined) as well as dynamic (time-developing) properties and characteristics acquired as a result of socialization that determine the specificities of a person’s social behavior and the spectrum of its possible life pathways. This 4-component system includes:

- time - the duration of the life cycle from birth to death,
- energy (“life force”), which we consider as:
  - health and physical capabilities of the individual,
  - psychophysiological characteristics and personality traits (sensing, motor skills, cognition, emotionality, will, memory, rigidity / lability, introversion/extroversion),
  - intensity and forms of manifestation of basic instincts: self-preservation, research, power (leadership), freedom, dignity, social aggression and social solidarity,
  - forms of interpersonal interaction (suggestion, counter- and counter-counter-suggestion (passive and active resistance to suggestion)),
  - value orientations,
- the economic resource of the individual (the amount of available economic goods and values),
- knowledge resource (available knowledge, abilities, skills, competencies).

The first two components have a biological basis, which, is adjusted by the social life conditions, while the other two are purely social. In our opinion, the relations IR with BP and HC and its features are: The innovative resource of a person is a combination of the characteristics of his/her vital resources that make their bearer optimally suitable for productive innovation. In turn, the HC of the innovator is the market assessment of the innovator as a kind of “investment project” of his family and him/herself, his/her share in the national capital. This share does not exhaust his/her contribution to the public good, which should include tax payments and contributions to charity. In addition, the indicators of human capital do not take into account the growth in the quality of life, which is not fully accounted by the indicators of national product and national wealth, as well as subsequent innovation cycles induced by innovators, which is not the subject of this work.

However, even such an incomplete accounting and superficial observation of economic life shows that the contribution of the largest innovators of the 20th - 21st centuries to the economies of their
activity countries and the world economy is comparable to the discovery of the richest deposits of gold, diamonds, oil, gas and new lands in previous centuries.

3. Actual directions of state management of the innovative process in actual conditions of Russia

Based on the realities noted above, it is natural that a number of modern states, especially those deprived of natural resources, but which have at least minimal starting conditions in a stably functioning system of general education, to go over to the path of innovative development, that promise significant long-term benefits. The authorities of Russia, the country that positions itself as “... a welfare state whose policy is aimed at creating conditions that ensure a decent life and free development of a person” [4], the country with huge reserves of natural resources, although not always conveniently located, is aware that raw materials orientation of the economy is acceptable as a short-term, maximum, medium-term vector of development, as a source of formation of financial resources for long-term and sustainable innovative development.

Consideration of the best world practices allows us to distinguish three main blocks of inputs to the national innovative process and a tool for managing its availability for state management:

- state order for socially significant innovations (short and medium term management cycle),
- national innovation resource (long-term cycle),
- institutional, legal, organizational, economic and socio-psychological conditions for its effective use (medium-term cycle).

The state order for socially significant innovations is, apparently, historically the first of the instruments of innovation governance. Its main areas are: defense innovation, public health, education, transport infrastructure, and environmental protection. The applicability and effectiveness depend on the quality of the existing and emerging national R&D, the possibilities of state venture financing, the ability of the state to adequately formulate requirements for an innovative product and achieve optimal results in the face of IR uncertainty. The last two conditions should be discussed in more detail.

The ability of governmental agencies to adequately formulate requirements for innovation, excluding the specific area of defense, depends on their ability to organize and productively use the results of a trilateral public discussion with the participation of civil servants, experts in the management of the relevant area, and expert practitioners in this area and the general public. The area of consensus reached can serve as a basis for informed decisions in this part.

Achievement by the state of optimal results of the fulfillment of state orders means getting as close as possible to the expected results while minimizing losses and other social costs generated by the uncertainty of the innovative process. Solving this problem will require, in particular, a change in the role of scientific expertise in two directions: increasing the economic responsibility of experts for the results of the expertise and increasing the influence of the reliability of previous expert assessments on the credibility of new expertise. Only the first steps are being taken in these directions [5].

The formation of the national IR as the most important integral part of the VR of the nation does not go unnoticed by the Russian Government. The list of 16 state programs of the Russian Federation, containing measures for the development of the national innovation system, also includes the state program of the Russian Federation “Development of Education” for 2013 - 2020 [6]. She solved a number of important problems, in particular, the initial digitalization of the educational process. However, in order to turn the educational system into a key factor in the formation of a national IR, we need a new version of such a program, aimed at solving the following urgent problems:

- development of a new State Educational Standard (SES), orienting the educational process to the scientific, technological, socio-economic and cultural realities of an innovative, information society,
- ensuring, within the framework of a single educational process, the multivariate of educational trajectories that differ in the breadth and depth of knowledge development, taking into account the individual psychological characteristics and interests of students,
- guaranteed mastering of the basic volume of knowledge in accordance with the SES,
• individualization of training, combining it with a system of corrective feedback and continuous assessment of educational results,

• formation, on the basis of such an assessment, of individual dynamic cognitive profiles of students [7,8], containing both actual assessments of the results of the educational process, and cognitive-psychological characteristics of the student, obtained during monitoring of education. Validity, non-falsifiability and rechecking of such assessments, achieved due to the totality, continuity, cross-verification and preservation of the learning history, can be higher than with state final attestation (SFA) in its various forms with incomparably lower physical and psychological loads of the attested. These cognitive-psychological characteristics of students obtained during monitoring can serve as a reliable guide for choosing further educational and work paths.

The didactic core of such a mass system of individualized education should be a system of programmed learning applications based on artificial intelligence. Such applications are hypertext, combining training and control frames, the passage of which allows you to step-by-step mastering the material, identify and guide the correction of errors, check residual knowledge; equipped with modules for monitoring and recording the individual course of training and its results, they will allow solving not only educational, but also evaluative and employment-oriented tasks. The role of the teacher in such a system can be concentrated on solving the setting, motivating, corrective and orientation problems.

The implementation of such a program in full will take more than 22 years. In addition to the development stage (2 - 4 years), it is necessary to complete one or two graduations in the full training cycle in accordance with the new SES and new teaching technologies (11 years - secondary education, 4 years - bachelor’s degree, 2 years - master’s degree), and 2 years for assessment of the new technology’s efficiency. It will require the joint efforts of specialists from almost all branches of knowledge (in terms of the formation of relevant SES), and, in particular, scientists in the field of pedagogy, developmental and cognitive psychology, psychology and sociology of values and attitudes, specialists in the field of artificial intelligence and information technology, computer technology, as well as significant material costs. However, without the implementation of such a program in one form or another, the creation of a large and high-quality IR is hardly possible.

As for the third direction of state management of the national innovative process - the creation of institutional, legal, organizational, economic and socio-psychological prerequisites for the effective use of IR. The following are indicated here.

In terms of institutional and legal prerequisites, two related tasks seem to be the most relevant: strengthening the protection of intellectual property, in particular, patent protection against unauthorized use and preventing the monopoly restriction of market access for alternative innovative solutions.

In the field of creating organizational and economic prerequisites, it is extremely important, together with the continuation of government efforts to create technology parks, technopolises, innovative development zones, grant venture funds, to concentrate the available financial resources on the support and accelerated development of the country’s most important scientific and technological schools. The program goals, that have been set for them are the best use of our national wealth for the needs of innovative development. It would be also useful to restore, develop and ensure the normal functioning of scientific and technical museums, centers of children’s scientific and technical creativity, also in collaboration with interested higher educational institutions. It is also necessary to strengthen support for beginners, young innovators in terms of facilitating and reducing the cost of access to patent databases, payment of patent services and patent fees to protect the results of innovation.

Finally, within the creation of socio-psychological prerequisites for the effective use of national IR, it is necessary to form and maintain in all layers of public consciousness a positive image of the innovator as one of the most important key figures in the innovation society.

The ability of the Russian public administration to concretize and organize the solution of these problems is the main factor that determines the pace of building an innovative economy and an innovative society.
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