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Special Issue for "Family, Education, Culture: Developmental and Management Characteristics of the Social Institutions and Processes Under Contemporary Conditions"

## Advanced Education in the Information Society

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### ABSTRACT

The sustainable civilizational development of the society is a necessary condition for ensuring a high level and quality of life of people, their reliable social security. The basis of the strategy of sustainable development of the society is the advanced training. Realization of the concept of advanced training involves the formation of the ability of the education system to "foresee" its future and make decisions about its actions in the present in accordance with this foresight. In the conditions of Russia's moving towards the information society, new possibilities open up of innovative development of domestic education, improvement of efficiency of the educational process. The article discusses the prospects of innovative development of the Russian education (RE) on the basis of realization of the opportunities offered by the information society. A methodology is formulated of the management of innovative development of education in the conditions of information society. A concept is put forward and substantiates of the next-generation intelligent system of management of innovative development of the RE, which is capable of advanced training of specialists with professional skills and abilities that will allow them to work in those areas of knowledge and competencies that will only appear by the time of their graduation. Building of a next-generation intelligent system of management of innovative development of the RE presupposes implementation of the mechanism of synthesis of the management objective, the construction of a dynamic expert system, ensuring the integration of the system of forecasting/planning in the education sector with a system of forecasting in the area of science and technology and integrated forecasting of socio-economic development of the country, the use of participatory approach to planning, the use for the management of educational development of intelligent control technologies including or based on Anokhin's theory of functional systems.

**Keywords:** Advanced Education, Information Society, Blue Ocean Strategy, Participative Planning, Crowdsourcing

**JEL Classifications:** I21, I25, I28, O33

## 1. INTRODUCTION

### 1.1. Introducing the Problem

The sustainable civilizational development of the society is a necessary condition for ensuring a high level and quality of life of people, their reliable social security. "The transition to sustainable development should provide a long-term balanced solving of the problems of socio-economic development and preservation of favorable environment and the natural resource potential, meeting the needs of the present and future generations"<sup>1</sup>.

The stable and progressive socio-economic development of the Russian Federation (RF) and ensuring its competitiveness in the modern world must be based on the innovative development of all sectors of national economy, individual economic entities and their associations as a way of their existence through targeted changes in its qualitative state as a result of innovative activity in the conditions of changing environmental factors and/or their changing internal properties. In this context, the authors interpret innovative development of complex socio-economic systems as not only the basic process of innovation, but also the development of the factors and conditions necessary for its implementation.

<sup>1</sup> The Decree of the President of Russian Federation "On the Concept of the Russian Federation transition to sustainable development" (Kremlin.ru).

At the present stage, the main environmental factor for all complex socio-economic systems is the formation of global information

society. Knowledge gained by virtue of free access to information and the ability to work with it becomes a fundamental condition for the well-being of every person, every organization and every state in the information society. “Wealth, power, social well-being and cultural creativity in Russia in the XXI century will largely depend on its ability to develop a model of the information society, adapted to its specific values and goals” (Castells, 2004, p. 5).

The foundation of the global computer communication is the internet. On the basis of the internet there arise and develop the problem-oriented information-communication social spaces, which are a form of existence of relations, formed in the process of implementing by the economic entities of the economic and other activities with the use of advanced information-communication technologies (Meshkov, 2011). On the basis of common goals and values there are formed the problem-oriented internet communities – informal groups of internet users who have common interests and common objectives in the socio-economic sphere. “The modern communication platforms help to organize in a new way the collective actions of people and team them up for various social initiatives” (Medvedev, 2015). The failure of socio-economic systems to use the opportunities provided by the information society leads them to stagnation and degradation.

### 1.2. Exploring the Importance of the Problem

The key problem of the socio-economic development of Russia in modern conditions is the low competitiveness of virtually all major sectors of national economy. In many ways, this problem is conditioned by the fact that the organs of state power and administration, organizations and citizens do not fully utilize the opportunities offered by the information society.

Education is one of the determinant aspects of the society life, the most important resource of its sustainable development. In the forecast of the long-term socio-economic development of the RF for the period until 2030, developed by the Ministry of Economic Development of the RF, there is included the need to create a flexible and diversified vocational training system that meets the requirements of the labor market and the needs of innovative economy<sup>2</sup>.

Due to the thesis that, in the period of establishment in the society of a model of sustainable development, its emerging collective consciousness should outpace its being, there becomes vital today the transition from sustaining education, which is directed mainly to teaching the person the rational usage of the accumulated experience of past generations, to advanced education, aimed at solving the global challenges of our time, revealing the creative potential of the person, his/her ability to make responsible decisions in the conditions of uncertainty (Ursul, 1993; Kolin, 1996).

### 1.3. Describing the Relevant Scholarship

In most cases, our higher education institutions (HEIs) in their present state poorly develop socialization of the graduates.

<sup>2</sup> Forecast of long-term socio-economic development of the Russian Federation for the period till 2030 (Government.ru).

Therefore, we can formulate another requirement to the modern education system: In addition to the educational function of forming students’ professional competences and abilities, it must develop their skills of positive thinking, which blocks the influence of the so-called “limited rationality” and which is designed to improve the inclination of young professionals to interaction.

The result should be a reduction in the likelihood of opportunistic behavior among them, and, as a consequence, an increase of the level of their negotiability (Auzan, 2014; Auzan, 2015). In the future, it is necessary to come to such an education system that will be capable of forming professionals with new value archetypes, specialists who are willing and able to cooperate in a competitive environment (including through clear understanding of their rights and ways to protect them, as well as the benefits of working in the network-centric structures automatically protecting these rights).

The strategy of advanced education is characterized by:

- Increased requirements to the level of preliminary training of students;
- Anticipatory character of the learning content;
- Innovative character of the realized educational technologies;
- Elite character of scientific-educational schools;
- Development of strategic partnership of educational institutions with the research and industrial organizations.

All participants in the educational process are objectively interested in the development of a system of advanced education. The orientation of educational and scientific-pedagogical workers toward the advanced education becomes an effective factor of improving the quality of training of young professionals, a strong argument in the competition on the market of educational services. Students receive education, which will not lose its relevance for a long time. Employers gain confidence that soon there will come to them the employees prepared to work in the conditions that are still being formed, but can become dominant in the future.

The innovative orientation of modern organizational-economic processes in the education sector poses specific requirements for the content, organization, forms and methods of management of innovation development of the Russian education (RE), taking into account the increasing importance in the information society of the immaterial forms and qualitative non-traditional factors of economic growth, the phenomenon of transformation of institutions of higher vocational education through entrepreneurial activity (Clark, 1998; Gibb, 2012).

At the initial stage of training it is necessary to give students the opportunity to take extra courses of their choice in order to definitively determine the choice of profession, to take special courses with the participation of leading domestic and foreign experts in a field of science, business, etc. (using the experience of the HSE, Skolkovo Tech, MPTI, ITMO and others).

Implementation of the concept of advanced education presupposes the formation of the ability of the education system to “foresee” the future and be able to make decisions about its actions in the present in accordance with this foresight. “The main innovation

process, in which the entire world education should be engaged, is not only its modernization (upgrading), but also its futurization, involving all currently existing and possible in the future advance factors and anticipatory mechanisms” (Ursul, 2009, p. 18).

#### 1.4. Stating Hypotheses and their Correspondence to the Research Design

There are in Russia some individual successful examples of implementation of the concept, proposed by Etzkowitz, of a “triple helix of interaction between universities, business and government” (Etzkowitz, 2008; Dudin et al., 2014); however, these are, first, individual examples, and, second, there is becoming more and more widespread in the world the concept of the National Open Innovation System (NOIS) (Santonen et al., 2007; Peshina and Avdeev, 2014), the main feature of which is the construction of a network-centric model based on the study of interaction processes between not such major entities as universities, states and business structures but the people directly involved in these processes, which forms the basis for the study and consideration of the accelerating processes of formation of the network training and research (knowledge-generating) systems which will be able to form network counterparts of modern universities. Moreover, the authors of NOIS have already created specific recommendations for supporting the individual creativity. The reason is that it is exactly the systems, taking into account the “collective wisdom” of all the participants (both students and teachers, and potential consumers), that will be able to track the appearance in the “collective consciousness” of these participants of those new fears and needs that will arise after the appearance in the environment in which they live, learn and work some new processes and/or properties generated by the innovative technologies which are introduced into practice. Thus, this system of education will be able to predicatively identify where, at the intersection of which actions and developments there will arise the “germs” of those new markets in which its graduates will have to work.

When selecting the directions of advanced training of specialists for the projected future, one should be guided by the strategy of “blue ocean” (Kim and Mauborgne, 2005). “Blue oceans” in the field of higher education are unknown, competition-free subject areas, in which the demand is not conquered, but is created. The “blue ocean” strategy aims to reorient the organization from competitors to alternatives, to bring it beyond the “scarlet ocean” of competition and create for it such market niches where for a while there will be no fear of rivals.

On December 4, 2014 Russian President Vladimir Putin in his Address to the Federal Assembly voiced the idea of the National Technology Initiative (NTI): “On the basis of long-term forecasting it is necessary to understand what challenges will Russia face in 10-15 years, which innovative solutions will be needed in order to ensure national security, higher quality of life of people, development of the sectors of the new technological mode” (Putin, 2014). On October 16, 2015, opening the meeting of the Presidium of the Presidential Council of the RF on economic modernization and innovative development of Russia, devoted to the NTI issues, Russian Prime Minister Dmitry Medvedev drew attention of the

meeting participants to the relevance and importance of NTI for the country. “We should not miss the opportunities associated with the formation of new technological markets. The meaning of the national initiative is precisely in the creation in our country of the conditions for the development of industries that will become the leading sectors in the world economy, perhaps not now but in 20-25 years” (Medvedev, 2015).

The strategic nature of NTI, its orientation towards the future result in putting forward of special requirements for the level and quality of training of the specialists, called to participate in its implementation. However, the flow of publications on the problems and prospects of innovative development of the RE through the implementation of the opportunities offered by the information society is still not intense enough. Under these conditions, it is extremely urgent, vital for the country to develop a concept of a next-generation intelligent system of management of innovative development of the RE, capable of advanced training of specialists with professional skills and abilities that will allow them to work in those areas of knowledge and competencies that will appear only by the time of their graduation.

## 2. THE PURPOSE AND OBJECTIVES OF THE STUDY

This article continues a series of works by the authors on the analysis of the ways and prospects of modernization and innovative development of the RE in the conditions of information society. In these works there are formulated, in particular, the following basic definitions (Meshkov, 2014):

RE complex (REC) is a set of interconnected and interacting business entities, realizing a common goal in the process of their coordinated functioning, which is to ensure the social and spiritual consolidation, competitiveness and security of the nation, the individual, society and the state through education, socio-pedagogical support of the formation and development of the highly moral, responsible, creative, proactive and competent citizen of Russia;

Information-communication educational space (ICES) is a form of existence of the relations, formed in the process of realization by the REC entities of educational activities with the use of advanced information and communication technologies.

Information-analytical internet portal of REC is a global self-developing problem-oriented information-communication system, based on the latest Internet technologies, a virtual organization providing users the ability of distributed and decentralized work, a highly effective media outlet, a tool of public and administrative control over the activities of state and local authorities, other economic entities in the field of education, a social network of the consumers and producers of educational services and the products of educational purpose, employers.

Educational web community is an association of people having common interests and common goal: The formation and

development of the highly moral, responsible, creative, proactive and competent citizen of Russia.

The aim of the conducted study is to develop a concept of a forward-looking intelligent system of management of innovative development of RE, capable of advanced training of specialists with professional skills and abilities that will allow them to work in the areas of knowledge and competencies that will appear only by the time of their graduation.

The attainment of the research objective is associated with solving the following problems:

- To create a methodology of management of innovative development of RE in the conditions of information society;
- To develop a concept of the information-analytical internet portal of REC as a key system-forming element of innovation infrastructure of ICES;
- To formulate the principles of construction, to determine the composition and structure of a next-generation intelligent system of management of innovative development of RE.

The object of study: The REC.

The subject of study: The principles of functioning, composition and structure of a next-generation intelligent system of management of innovative development of the Russian education.

### 3. METHOD

Solving the research problems was carried out on the basis of the methods of system analysis and system synthesis, control theory, Anokhin's theory of functional systems, self-organization theory, economic-mathematical modeling, forecasting, computer science, sociology, and others. The validity and reliability of the research results is provided by using a system approach to the analysis of the phenomena and processes taking place in education.

### 4. RESULTS

#### 4.1. Methodology of Management of Innovative Development of RE in the Conditions of Information Society

The proposed methodology of management of innovative development of RE in the conditions of information society has the following structure:

- The foundations of methodology: The concept of sustainable development, the concept of advanced education, system analysis, system synthesis, control theory, Anokhin's theory of functional systems, the theory of self-organization, economic-mathematical modeling, forecasting, computer science, sociology.

The characteristics of the activity:

- Special features: The specificities of management of innovative development of RE are determined by the specifics of the Russian concept of education;

- Principles: Management of innovative development of RE presupposes the control over the increase and realization of the innovative potential of REC; the structure and content of the principles of management of innovative development of RE depend on its purpose and essence;
- Conditions: Formation of the information society, formation and development of ICES, the formation of an educational web community;
- Norms: Legal and ethical norms governing the functioning of REC, as well as the ordering relations of the REC subjects with one another, state and municipal authorities, commercial and non-profit organizations and citizens – the consumers of educational services and the goods of educational purpose, which are formed and developed in ICES;

Logical structure of activity:

- Entities: Pre-university institutions (university lyceums) and other specialized schools (physico-mathematical, technical, etc.), HEIs, scientific research organizations, public authorities and local self-government, political parties and civil society organizations, institutional entities, business entities, which are included into REC;
- Object: Economic and information processes of formation and organization of effective functioning of the innovation sphere of RE;
- Subject: Management relations arising in the process of innovative development of RE in the conditions of information society;
- Forms: Traditional forms of administrative activity in education, as well as modern forms of network management;
- Means: Traditional means of innovation management, as well as a problem-oriented information-analytical internet portal of REC and an intelligent system of management of innovative development of RE built on its basis;
- Methods: Traditional methods of management of the processes in the education system, as well as a method of constructing an intelligent system of management of innovative development of RE, presupposing the implementation of the mechanism of synthesis of the management objective, dynamic expert system, methods of analysis and big data processing, crowdsourcing, self-organization, decision-making support, forecasting and foresight, combined within a Anokhin's functional structure;
- Results: Next-generation intelligent system of management of innovative development of RE, which has the capacity for advanced training of specialists with professional skills and abilities that will allow them to work in the areas of knowledge and competencies that will only appear at the time of their graduation;

Temporal structure of activity:

- First stage: Studying special features of innovative development of RE in the conditions of information society, studying the conditions of formation and development of ICES, the assessment of its innovation potential;
- Second stage: Creating a problem-oriented information-analytical internet portal of REC as a key system-forming element of the innovation infrastructure of ICES, formation



of virtual and real innovative scientific-educational clusters on the basis of the REC portal;

- Third stage: Designing a next-generation intelligent system of management of innovative development of RE, which is capable of advanced training of specialists with professional skills and abilities that will allow them to work in the areas of knowledge and competencies that will only appear by the time of their graduation, that will also be the foundation for the emergence of a virtual research environment forming the conditions for the emergence of collective intelligence and continuous foresight, integrated in the processes of learning and research activity.

#### 4.2. The Concept of an Information-Analytical Internet Portal of REC

The following question is vital to the Russian economy today: Does the innovation infrastructure created in Russia correspond to the formed model of economic development and its development in the medium term? The authors of a recent study “The development agenda of the innovation infrastructure in the RF” (Shadrin et al., 2015) take note of the absence in RF of an institutional framework of innovation activity and innovation infrastructure.

A new positive impetus to the innovative development of education should come from the creation of an integrated nationwide information-analytical internet portal of REC, a key system-forming element of innovation infrastructure of ICES. The most important socio-political objective of the REC portal is to promote implementing the state educational policy. The main scientific-practical task of the portal is to facilitate the formation and development of ICES, accumulation, storage and actualization of information on the issues of providing the social and the spiritual, competitiveness and security of the nation, the individual, society and the state through upbringing, socio-pedagogical support of the formation and development of the highly moral, responsible, creative, proactive and competent citizen, to create a unique in terms of its content and size database on the issues of education (Meshkov, 2014).

The development strategy of the REC portal presupposes the increased activity of the public authorities and local self-government, the REC institutions, research and industrial organizations and citizens in ICES. At the stages of growth and maturity of the portal, the main contribution into its content formation will be made by its participants and users according to a crowdsourcing scheme. The financing of the operation and development of the portal will be provided, to a significant extent, by a crowdfunding scheme. The interrelation between the portal and the portal participants are built according to an outsourcing scheme. As an outsourcer, the REC portal offers to all its participants a widest range of services and resources, including the creation and support of functioning of their autonomous internet representative offices within the framework of the portal. The portal participants, having signed an agreement with the portal concerning the creation, technical support and development of their internet-offices, acquire a wide complex of competitive advantages.

On the basis of the REC portal there are formed the systems of virtual and real innovative scientific-educational clusters: Dynamic associations of legally independent REC entities, scientific research and industrial organizations, as well as the corresponding institutional subjects, based on their common economic and other interests and the coordinated ideas about the content of the jointly realized innovative processes in the education sphere, the systems of means and competences of which are formed by way of intersection of autonomous systems of goals of their participants, the relations between which, as well as between them and other economic entities, arise and develop primarily in the information-communication space. The main purpose of the cluster policy in the sphere of education is to concentrate the innovation potential of the cluster participants in order to achieve the global competitiveness in the market of educational services and the goods of educational purpose (Bortnik et al., 2015).

The main directions of interaction between the REC subjects and the research and industrial organizations in the framework of innovative scientific-educational clusters are:

- Realization of educational programs on the priority for the industrial entities directions of the advanced training, re-training and the qualification improvement of the personnel, first of all, the engineering one;
- Creation of a system, which includes multiuser open educational courses and crowdsourcing solutions, providing a possibility of collective project training and joint finding of efficient solutions on the NTI projects;
- Joint carrying out of scientific and applied research;
- Integration and cooperative usage of scientific-information resources, innovation infrastructure of the REC subjects and the material-technical base of the scientific and industrial organizations in the interest of science and business.

As a result of development of the integration processes, initiated by the REC portal, there arise in ICES a powerful positive synergetic effect. The realization of synergism in ICES facilitates the increasing of effectiveness of functioning of the market of educational services and the goods of educational purpose.

A significant positive influence on the REC development will be exerted by the innovation activity, organized by a noosourcing scheme, of the expert professional web community formed on the basis of the REC portal (Slavin, 2012; Slavin, 2014).

#### 4.3. Principles of Design, Composition and Structure of a Next-Generation Intelligent System of Management of Innovative Development of RE

Into the foundation of the design of a next-generation intelligent system of management of innovative development of RE there should be put the following principles:

- Maximum usage of the opportunities offered by the information society;
- Fostering the formation and development of ICES;
- Recognition of the information-analytical Internet portal of REC as a key system-forming element of innovation infrastructure of ICES;

- The usage of advanced approach to training, which presupposes the orientation toward the predicted future of Russia;
- Selection of the directions of advanced training of the specialists for the predicted future in accordance with the “blue ocean” strategy;
- The use of pre-active planning, which consists of predicting the future (forecasting of socio-economic development in the long-term) and preparation for it, including the planning of the need of economic complex of Russia in the workers of certain professions, including the perspective ones, and reflection of this in the training programs;
- The use of a participatory approach to planning, which presupposes direct involvement in the planning process of all participants of educational processes (Ackoff, 1981);
- Ensuring the integration of the system of forecasting/planning in the education sector with the system of forecasting in the sphere of science and technology and the integrated forecasting of socio-economic development of the country;
- Development of strategic partnerships of the REC entities with the economic entities of the real sector of economy;
- Increased participation of students, Master’s Degree students and graduate students in the research and development work related to the areas of advanced training<sup>3</sup>;
- The use of intelligent control technologies, involving or based on Anokhin’s theory of functional systems, for the management of innovative development of RE (Anokhin, 1978);
- Application of the self-organization method in building predictive models in the intelligent system of management of the innovative development of RE (Ivakhnenko and Müller, 1985).

Effective management of modernization and innovative development of RE, the introduction of the concept of advanced education are impossible without relying on the complete, true-to-fact and up-to-date data on the phenomena and processes specific to the field of education, the trends and contradictions of their development. The strategy of advanced training involves carrying out by the education authorities and directly by the HEIs themselves the continuous monitoring and forecasting of the state of labor market, taking into account the structural changes in the economy and society in order to make the appropriate adjustments into the education process.

The REC portal offers to the organizers of national education a wide range of opportunities for conducting large-scale multi-dimensional social and marketing researches in the field of education, the results of which form the foundation of the information base of forecasting. In recent years, in Russia, like in the entire civilized world, there is becoming increasingly widespread the concept of socially oriented (social-ethical, social-ethic) marketing (Kotler, 1984). Within the concept of socially oriented marketing, as the main task of entrepreneurial activity

there is recognized the determination of needs, requirements and interests of the target markets and ensuring the desired level of satisfaction of customers by more efficient and more productive ways in comparison to competitors while simultaneously maintaining or enhancing the well-being of consumers and the society as a whole. Under such approach to the management of the RE development, a priority issue is to assess the balance of possibilities of realizing the rights and legitimate interests of all participants in the educational process.

Such a solution is within the worldwide trend. The research of the international auditing and consulting firm PricewaterhouseCoopers has shown that the innovation activity can be significantly enhanced through social networks, which offer many opportunities for communication between people with different experiences, outlook and views of life (Hobbs and Mahdi, 2011; Percival et al., 2013; Ordinarcev et al., 2013). It is important that such networks contain the elements of automatic protection and taking into account the priorities and rights of the authors of ideas.

Thus, with proper organization, the REC portal allows engaging into the operations management of the projects of the NTI Roadmap of a significant number of interested people all over the country, which can give a significant positive effect, including saving the project management costs by way of:

- The use of advanced approach to training, involving the orientation toward the predicted future of Russia;
- Involvement into the process of a significant number of people who can be called “visionaries”: They are capable of anticipating, better than others, what can best be of interest to the consumers of the future markets;
- Implementation of the principles of social enterprise, when the ideas, voiced by any portal participant, concerning the principles of management in the field of education, after their specially organized discussion can become mechanisms of control of the REC entities, which get competitive advantages from this;
- Reducing the time and savings costs for verification of the hypotheses of value-related proposals;
- Timely identification of the direction of the really demanded innovations.

Timely reconsideration of the drivers of innovation development for at least the medium term is one of the most important tasks in the implementation of NTI.

Also, the REC portal can allow creating a certain new kind of community of the realizers of various projects, which will concern not the job places or office structures, but new meanings, goals and values. If done right, this community should help to reduce the “brain drain” from Russia, because in the heyday of IT-technology it is important, first of all, not where the carrier of competencies lives, but in the interests of which country he/she realizes them. This approach is increasingly being used in solving scientific-engineering and socio-economic problems. For its implementation there has been already created a number of technological network platforms in various fields (lumenogic.com; Eurekamed.com),

3 There is worth studying, generalizing and disseminating a long experience in this field, in particular, the experience of the Student Design Bureau of the Moscow Institute of Electronics and Mathematics (skb.miem.edu.ru) and the Business Incubator of the Higher School of Economics (inc.hse.ru).

and its integration with the education system appears to be very promising.

It should be added that a similar mechanism of interaction can be very effective in critical evaluation and testing of new concepts (Challenge.gov; Smb.Sberbank21.ru).

At the macro level (the level of the RF and the subjects of RF), the following problems are primarily solved with the help of the REC portal:

- Organization and carrying out monitoring of the satisfaction of students and their parents, specialized civic organizations, the general public by the quality, volume and conditions of receiving educational services;
- Organization and monitoring of employers' satisfaction with the quality of training of the graduates of educational institutions;
- Organization and carrying out of monitoring of satisfaction of teachers and other employees of REC with the conditions of providing educational services.

At the micro level (the level of individual REC entities), there is realized a wide range of functions of the marketing support of specific educational services. And the main task of education managers in this case is not to first successfully attract applicants and then "sell" well the graduates, but to correctly determine which specialists (with what competencies) and how many are needed by the Russian economy now, and, even more importantly, will be needed in the future, and to correspondingly form the effective advanced educational programs.

For the management of innovative development of RE in the conditions of information society, we propose to use intelligent control technologies, including or based on Anokhin's theory of functional systems: Complex self-regulating systems, in which various elements and levels of control join together to achieve the results desired by the systems. Realizing the opportunities offered by the information society, we can build a next-generation intelligent control system of innovative development of RE, which is a set of hardware and software, united by a single information-communication process, working in the interaction with a person (a group of people), capable of synthesizing a management objective and finding rational ways to achieve it on the basis of the information about the state of environment and the state of REC itself, as well as a prognosis for these states in the presence of motivation and constantly updated special knowledge. Building a next-generation intelligent system of management of innovative development of RE involves the implementation of the mechanism of synthesis of the management objective, a dynamic expert system, methods of self-organization, decision-making and forecasting, combined within the framework of a Anokhin's functional structure.

A purpose of management of innovative development of REC is formed on the basis of knowledge and motivation mechanism. For the formation of a purpose there is needed complete, accurate and up-to-date information about the state of the system and the external environment. The information about the correspondence between the activity results and the forecast comes to the expert

system and to the system of synthesis of a management objective. A functional subsystem, realizing the mechanism of motivation, is an ensemble of criteria and rules of the purpose selection.

The central element of the next-generation intelligent system of management of innovative development of RE is an acceptor of action, which, possessing statistical and expert information, performs extrapolation of the controlled parameters of innovative development of RE and comparison of the extrapolation results with the results of measurements. A report on the correspondence of the action results and the forecast is transmitted to the expert system and the system of synthesis of the management objective. If the result of actions matches the forecast, the goal of management is recognized as reached, whereas the selected management, correct. In the case of mismatch between the result of action and the forecast, a new expert evaluation is performed, a new decision is made and a new control action is realized. If it turns out that it is impossible in principle to achieve matching, a change of the management goal take place: A new goal is synthesized.

To identify and study the trends, which exert a dominant influence on the development of RE, modeling and forecasting in this field in the next-generation system of innovative development of RE, one can use the appropriate system economic-mathematical models. However, in the conditions of permanent significant changes in the environment of functioning and the own state of REC, these models, which are formed by equations with rigidly specified structure, often, with the passage of time, fail to continue being adequate to the real processes. In this regard, we propose to carry out the construction of predictive models using the method of self-organization, in particular, using the solutions based on multi-agent and genetic algorithms. It is very important that the self-organizing models can be built in the process of functioning of the system.

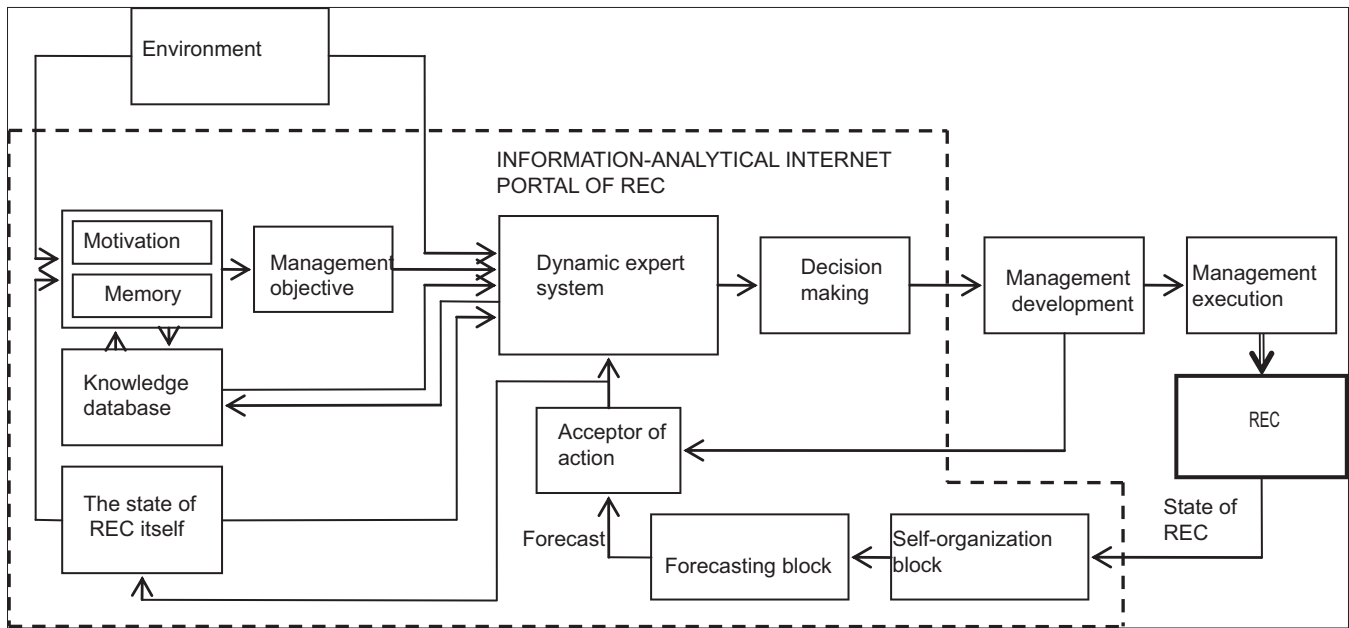
Since the structure of the self-organizing model is a priori unknown, it is very problematic to use for management. In connection with this, it is proposed to use, as an a priori model, an equation with a rigidly specified structure, whereas the self-organizing model is to be used for forecasting, on the basis of which a control decision will be made. A specially organized crowdsourcing will help to improve the efficiency of such system.

A next-generation intelligent control system of innovative development of the RE can be built on the basis of the information-analytical internet portal of REC (Figure 1):

In this system the REC portal will carry out the following functions:

- Collection, accumulation and storage of information on the state of environment and the state of REC itself;
- Synthesis of a management objective on the basis of active evaluation of information about the state of environment and the state of REC itself, together with the prognosis of these states in the presence of motivation and special knowledge;
- Formation and development of a database of knowledge concerning various aspects of educational activity;
- Development of an assessment required for decision-making, as well as a forecast for the acceptor of action;

**Figure 1:** The structure of an intellectual system of management of innovative development of the Russian education, built on the basis of the information-analytical internet portal of Russian education complex



- Decision-making;
- Verification by the acceptor of matching of the action result (under the implementation of the selected control) to the forecast.

## 5. DISCUSSION

In addition to performing its main functions, the next-generation intelligent control system of innovative development of RE should be focused on fulfilling the following tasks:

- Training students to work in a team;
- Providing the organizational, financial and information support for the student start-ups;
- The development of relations in the sphere of exchange of experience and students with foreign universities and research centers;
- Sustainable reduction in the number of educational institutions through their merging, while simultaneously expanding the opportunities to train in different educational direction due to improving the remote accessibility of learning and its effectiveness;
- Strengthening and expansion of cooperation with the Russian Academy of Sciences in the educational process, creation (using the network technologies) at the HEIs of basic departments of scientific organizations of the Russian Academy of Sciences and scientific-educational clusters;
- The formation of specialists with new value archetypes with high negotiability, able to work in the conditions of competition;
- Forecasting of occurrence in the “collective consciousness” of all participants of the educational process of new fears and needs that can become reality with the appearance in the environment, in which they live, learn and work, of new processes and/or the properties generated by the innovative technologies which are introduced into practice.

Of particular interest to the REC subjects will be the possibility of creation, on the basis of the REC portal, of a “collective arbiter,” thanks to which each of them will be able to sign with any individual or more other subjects a long-term contract under conditions of uncertainty (“neoclassical contract”). It is clear that in the implementation of innovation projects not all future events can be stipulated as conditions in signing contracts. To make provisions for optimal adaptation to some events is practically unreal. A solution of this problem is to attract, by agreement of contracting parties, a third party, the decision of which the parties undertake to execute in the case of events not specified by the contract. Within the REC portal, as such “collective arbiter” there can act the entire educational web community.

One more thing: The application of such approach together with the measures of material stimulation should help to solve a particular but important issue for the Russian economy – recruitment to the training in the “disappearing” professions. The very formulation of the problem shows that, to solve it, it is necessary to provide to those young people who decide to master a “retro-profession” the fulfillment of the following two conditions:

- To ensure the wage level sufficient for the formation, including by individual investments (perhaps by creating for these categories of workers of some special, focused only on them, private pension funds with specific preferences on taxation), of savings which by the time, when they will be no longer in demand along with the equipment they worked on, will provide them for the entire remaining period of life with at least the national average level of well-being. In addition, it will be possibly needed to legislatively set a lower retirement age for them, which will be in the interest of the passive part of the employees, working in these professions because they are not able to even get close to the level of knowledge required for the passage of competitions for the recruitment or training in the promising directions of work;



- Provide for the workers, who will come into these professions for any other reasons including because they lacked few points on the competition for the best directions of work, a possibility of taking additional training in order to master new professions, so that by the time the equipment they work on will be taken out of business, they will possess the competences sufficient for the employment in the new, promising areas of economic development of the country.

The next-generation system of management of innovative development of RE should provide them with this opportunity, while taking into account the fact that the complexity of their training will increase from year to year: Due to both an objective reason of the used educational technologies becoming more and more sophisticated and the increased age of the students.

In addition to the above, we note another possibility for a next-generation system of management of innovative development of RE, which can be derived from a problem analyzed by Antasyuk as part of the trainee program at the Agency for Strategic Initiatives (Antasyuk, 2015).

The overwhelming majority of working Russians experience stress at their workplace. This inevitably gives rise to increase in diseases of various origins. Hence the problem: How to ensure sustainable development of the country, almost all the population of which is constantly exposed to stress factors? An effective method for solving this problem is the transition of the organizations and employees whose activities can be performed outside the working premises to the home-office mode of work. For the employers, such mode of work is a possibility to significantly save on costs necessary for the organization of the workplace. According to the estimates of the Nortel Company, saving on lease of the premises per one specialist is about 9 thousand dollars per year. For example, in 2012 the Dell Company with the 20% share of remote workers saved 14 million dollars. British Telecom, Best Buy and Dow Chemical have also noticed that, due to transition of a specialist to remote work, the productivity increases by 40%. A study commissioned by the Cisco company (there were interviewed 1827 employees of 50 companies in Australia and New Zealand, and there were conducted 100 interviews with managers) revealed that 71% of respondents reported a positive impact of the remote work on their attitude to work. Now, from the point of view of NTI it is important that it is the employees who work remotely that are most often the initiators of the introduction in the companies of new technologies (10% more often than usual). As a result, 84% of employers from the list of best companies to work in – according to Forbes in 2013 – provide an opportunity to work remotely. For example, the remote mode of work is used by IBM, Twitter, Cisco, Netflix, Microsoft, Dell, Nortel, British Telecom, Dow Chemical. Over the past 5 years the number of people working remotely has been growing each year by 24% on average. And according to the forecasts of many futurologists, in the future this form of work will become the norm (tvoy-start.ru, 2013; Interfax-Russia.ru, 2014; Arden, 2014; B2Blogger.com, 2014).

This conclusion is directly related to the creation of a next-generation intelligent system of management of innovative

development of RE and its application for solving the problems of NTI. First, as mentioned earlier, with the development of additive technologies, the increased robotization of industries, the use of three-dimensional-printing and digital simulation, it will be possible to carry out the increasing number of activities remotely, and therefore the students are advised to develop skills for such activity already during training in the HEIs, whereas their future employers are recommended to prepare appropriate for them formats of control and execution of projects. Second, this portal allows testing different methods of organization and use of the crowdsourcing mechanisms and select the most effective ones, which will enable to increase the efficiency of realization of the potential of the employees working remotely, as well as the ones engaged temporarily for certain projects. Third, the system, which includes various, including short-term multiplayer open educational courses, can become a platform for the mass retraining, professional reorientation and additional vocational education. And fourth, this form of organization of both individual and collective work is very convenient for the companies that, because of specificity of their activity, often change the location of their main activity, often send their personnel on business trips, etc. (HR-Portal.ru, 2015).

The state should become the initiator of the creation of an information-analytical internet portal of REC and, on its basis, a next-generation intelligent system of management of innovative development of RE. The Russian economy, which is not yet fully market-oriented, has one important advantage: To a significant extent, the state influences the processes in the field of higher professional education, still using not only organizational-economic, but also administrative leverage. In case of special need, the President and the Government of the RF can focus the efforts and resources on the strategic objectives of socio-economic development of the country, including those related to the field of science and technology.

## 6. CONCLUSIONS

Thus, from the above one can make the following generalizing conclusions:

- In the conditions of the country's moving toward the information society, new possibilities open up of innovative development of the RE, improvement of the efficiency and quality of the educational process connected with the formation and development of ICES;
- A key system-forming element of the innovation infrastructure of ICES is supposed to be a problem-oriented information-analytical Internet portal of REC;
- A large positive influence on the development of RE will be exerted by the innovative activity, organized by the noosourcing scheme, of the expert professional web community formed on the basis of the REC portal;
- For the management of innovative development of RE there is proposed to use intelligent control technologies, including or based on Anokhin's theory of functional systems;
- The construction of a next-generation intelligent control system of innovative development of RE presupposes implementation of the mechanism of synthesis of a control

objective, a dynamic expert system, analysis and processing of big data, crowdsourcing, self-organization, decision-making support, forecasting and foresight, united under the framework of Anokhin's functional structure;

- To identify and study the trends, that exert a dominant influence on the development of RE, modeling and forecasting in this field in a next-generation system of management of innovative development of RE, it is proposed to use the appropriate system economic-mathematical models;
- A next-generation intelligent system of management of innovative development of RE can be built on the basis of the information-analytical Internet portal of REC.

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