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Research and Educational Network: Development Management

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ABSTRACT

Relevance of the study is determined by the fact that the management methodology of research and educational network development being of great interest for the improvement of the educational system, currently remains beyond the most scientific researches. Study purpose is aimed at the development of the organizational and pedagogical management model of research and educational network development in the field of education. Leading theoretical method of the research is the structural and functional approach enabling comprehensive consideration of the contents of the main components of the developing research and educational network and dependencies between them. The article presents the organizational and pedagogical management model of the developing research and educational network, describing the objectives, principles of participants' interaction, functions, and structural networking components, revealing the scope of the activity, conditions, forms and types of the interaction. Materials may be useful to explore the possibilities of development of the intellectual capital of the subjects of network communication; training of specialists qualified in the field of generation and spread of new knowledge in the creation and development of research and education network.

KEYWORDS
Development of subjects of network interaction; intellectual capital; organizational and pedagogical model; research and educational network

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Introduction

The development of society within its various spheres in the last quarter of the twentieth century is characterized by a strong integration and globalization processes that appear in the educational system in different forms. In this aspect, the reference to the network interaction seems to be reasonable and logical since it updates the needs of the educational system in the effective self-

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determination and the qualitative resulting development. Therefore, the problem of network interaction development in educational institutions and industrial enterprises of different levels mentioned in the study is of particular importance, and characterized in this relation as an important social and pedagogical as well as social and economic problem. At the same time, the research and educational network shall mean "a dynamic set of interrelated agents representing scientific, educational, social and cultural organizations (their subdivisions and creative teams), as well as the elements of innovation infrastructure and industrial enterprises interested in the development of the educational system, which operates as a virtual organization and implements innovative projects in the field of education at a high level of objectives coordination and integration of all resources types, achieved through formation of internal network information space leading, as a result, to the creation of the collective intellectual property in the field of education and increase of external effect" (Fedorov & Davydova, 2014).

Literature Review

In solving the problems of research and educational network development, the possibility of expanding its influence beyond the social sphere into the sphere of the economy (manufacture) is of particular interest. Modern corporate educational complex integrates organizational structures of corporations and educational institutions into relatively integral network associations that govern the functional interaction of units of the production sector and the sphere of project-based learning. The cost, material and intellectual basis for such interaction serves a corporate order for training and personnel development of specific enterprises and organizations. In recent years, even major and financially large world-class universities believe that focusing on global leadership and sustainable competitive position requires more diversified and extensive resources, educational technologies and opportunities than they are able to create and implement on their own. With this respect, the organization of educational and scientific-research integration structures, the development of integrated programs aimed at pooling of resources in order to increase the competitiveness of each of the participants in the global educational system becomes of top priority. A number of researchers state that the ability to find knowledge and then apply it in practice may be implemented in different forms of cooperation; herewith, the variety forms of cooperation being not under the same "roof" of the property, constantly grows, thus providing a more efficient environment for the discovery of new knowledge (Grant & Baden-Fuller, 2004; Klarl, 2014). In the Great Britain, more than twenty universities have united in the elite interaction group Russell Group, in the United States The Ivy League brings together universities of Harvard, Princeton, Yale, Brown, Columbia, Cornell, Dartmouth and Pennsylvania. Such cooperation is formed on the principles of partnership, network interaction and forms strategic alliances aimed at quality improvement of the education and scientific and research activities (Duncan, 2003). A common form of cooperation was the participations of higher education institutions in the benchmarking networks aimed at finding and sharing the best management practices. For example, the European Centre for Strategic Management of Universities, ESMU (Belgium) supports the European Benchmarking Programme on University Management, the annual

program in terms of which the European universities are offered the opportunity to conduct a thorough comparative analysis of their activities.

In Russia, among the elements of network interaction for the purpose of integration processes development it is possible to highlight in the "education – science – production" system the creation of regional innovation and educational clusters, technological platforms, research and innovation networks, combining the efforts of production, educational and research organizations aimed at innovative development of the economy. In the educational system the network interaction is most often considered with regard to the organization of industry-specific training, training of teaching staff and organization of social and professional networks, organization and management of innovation activity, etc., with extensive use of the Internet. In particular, E.V. Vasilevskaya (2007) considers the network interaction as a communication system, allowing the development, testing and offering to professional pedagogical community innovative models of education content and educational system management (Vasilevskaya, 2007). S.A Shchennikov (2002) emphasized that in the network forms of organizations unlike hierarchical structures the openness, transparency, and controllability are achieved through self-organization, application of cooperation mechanisms and teamwork, as well as through impartiality of information technologies (Shchennikov, 2002). At the same time, a number of researchers understand network interaction as a specially created partnership environment and exchange of educational resources, where the consolidation of social forces interested in the development of education, the creation of knowledge community, the socialization and spread of the best teaching practice takes place (Adamski, 2002; Gromyko, 1996; Dmitrieva, 2015; Ignatyeva, Tulupova & Molkov, 2016; Fedorov & Davydova, 2013). During the past 10 years, the Russian State Vocational Pedagogical University in liaison with the Russian Academy of Education conduct systematic work on the development of network interaction of educational institutions of general and professional education, scientific and research organizations and enterprises in the form of research and educational network (Davydova, 2010) and on the formation of organizational and pedagogical development management model which the study is dedicated to.

Materials and Methods

Research methods

As a guiding principle, ideology and method of the scientific research a multi-level methodology, substantiating the allocation of the following stages, has been used: philosophical methods, general scientific, specific scientific and disciplinary methods. The leading theoretical research method was a structural and functional approach enabling to consider comprehensively the contents of the main components of the developing research and educational network and dependencies between them. The following theoretical methods have been widely used in the study: analysis, synthesis, specification, generalizations, analogies, modelling; diagnostic – questionnaire survey, interviewing, empirical – the study of educational institutions experience, regulatory and educational documentation, pedagogical observation, experimental – ascertaining, forming, control experiments, methods of mathematical statistics and graphic recording. The methods of assessing changes in the network interaction stability has taken

into account the definition of the intensity interaction index in the network, calculated as the ratio of the number of successful interactions in the network to a number of possible links in the network identified at the project stage. In addition, the ratio of links between the participants of interaction determined by common projects and intellectual products was studied in relation to the total number of links in the research and educational network.

Experimental research base

The Russian State Vocational Pedagogical University with up to 70 general educational institutions, 15 vocational training organizations and 5 industrial enterprises is the experimental base of the research.

Stages of research

The process of research and educational network development management provides for a specific sequence of actions, including conceptualization, programming its development process, planning the activity directions, development of individual innovation projects and managing the interaction of the network participants. The research was conducted in three stages:

- The first stage includes the theoretical analysis of the existing methodological approaches in the philosophical, psychological, pedagogical scientific literature and thesis works on the subject. In the course of the work, the problem has been highlighted, and the purpose and research methods, as well as a draft experimental research have been developed.

- The second stage includes the elaboration of the organizational and pedagogical management model of research and educational network development; identification and substantiation of a set of pedagogical factors of effective interaction of network participants, the performance of experimental work, the execution of analysis, validation and refinement of the findings obtained in the course of experimental work.

- The third stage consists of the refinement of theoretical and practical conclusions, summaries and systematization of the results.

Results

New management paradigm considers both individual network participants and research and educational network as open self-organizing systems with emergent properties, which management requires knowledge and correct application of synergy principles for the purpose of effective use of self-organization potential. Self-organization in relation to the research and educational network shall mean the system advancing to the self-development through upbuilding, “evolving” into new and more robust management structures. The difference of research and educational interaction, as a modern approach to the management of educational systems self-development is the wide application of network management forms of knowledge generation, providing a high level of concentration of non-codified knowledge, i.e. knowledge that cannot be transferred through computer networks, and high rate of diffusion of the codified knowledge. Moreover, the main directions of management support of self-organizing activity of scientific and educational institutions, network industrial enterprises include correct organization of social

space: tasks redistribution, delegation of authorities, horizontal links development, formation of a single "cultural field" of network interaction of organizations, development of subjective potential. The problem consists in the discovery and implementation of self-organizational and leadership potential of network community participants.

Proceeding to the modelling of management of research and educational network development it should be noted that the main concentration of resources in the knowledge-based economy is caused by the increase in the information flow circulating between network nodes, and the system complexity (here the research and educational network), is determined by the number of connections between the elements, which grows increasingly with respect to their number, rather than by the number of elements. Therefore, the research and educational network, which has a large number of participants, is represented in terms of its model as extremely complicated system, with a large number of internal cross-links, actively interacting with the external environment.

We propose to consider the scientific and educational network as a specially developed form for the expansion of innovative cultural and educational space of the network interaction participants, with the processing of new types of activity and forms of relationships, the exchange of knowledge with the shared use of educational resources to ensure the integrity, transparency and the opportunity of self-development of network interaction participants and the creation of new intelligent products. That is the basic *functional purpose* of the research and educational network is to create a set of conditions and mechanisms for self-organization and self-development of the participants of the innovation activity. In fact, we are talking about a new approach to the development management of educational, research organizations and enterprises for the development, learning and promotion of specific innovations. Research and educational network is a kind of joint capital for the educational institutions and industrial enterprises, which gives the basis for the development of all own capitals of network interaction participants. During the formation of this capital individual knowledge is transferred into intra-network knowledge and stored in the corporate database for common use by all participants of the research and educational network. The characteristic feature of the corporate knowledge is the possibility of its development in the "open source" mode, i.e., it is possible to take the knowledge from the network, improve it and return back to the network, consequently, the knowledge is not simply stored in the network, but undergoes self-development leading to new opportunities for the development of the interaction participants (Davydova, 2013)

The proposed model of research and educational network development is based on the ideas of structural and functional analysis, which "consists of two basic approaches: structural, from the structure analysis to the discovery of its functions, and functional when structures involved in these functions are detected."

The development basis of the network interaction subjects in the context of the research and educational network includes a pass to the experience in the preferred field of knowledge based on the modelling and experimentation. In this relation, the main goal of the pedagogical scientific research in terms of research and educational network development is the identification of new knowledge about pedagogical processes, training and education phenomena in certain

organizations – interaction participants, their distinctive features (structure, action, history of development), the objective logical relations between pedagogical processes and phenomena. This network enables the conversion (replacement, modification) of the knowledge, for example, "the combination and recombination" of knowledge and experience turning them into means of innovation. Committed to the development of new knowledge about pedagogical processes and phenomena leads to a logical occurrence in the research and educational network of the educational constituent aimed at the increase of the level of methodological culture of the network participants. The educational constituent draws special attention of the participants to the theoretical basis of design and construction of the educational process, to the awareness, formulation and creative solution of pedagogical problems and to methodological reflection by full-time-distance education of the interaction participants in conditions of developing cooperation and integration of the network subjects on the principles of self-development and self-education. The fundamental difference between research and educational network and other types of educational networks is that a "corporate architecture" of the network is projected in the direction from concepts and ideas of specific educational institutions and industrial enterprises development to the purposes and further to the operating model of the research and education network. This approach allows for the solution of specific development problems of organizations and enterprises, and forms a stable basis for the network functioning on the basis of the system interaction of collective pedagogical practices of various educational institutions.

The represented organizational and pedagogical model is the basis for managing processes of self-organization and self-development of the subjects of joint activities, the creation of collective intellectual property within the development of the research and educational network (Figure 1).

Research and educational network development purpose.
The integration of scientific, educational, social and cultural organizations interested in the development of educational system of economic-oriented institutions in order to ensure self-organization and self-development of the subjects of innovation activity to create, develop and promote specific innovations in the educational system.

Interaction participants.
Dynamic number of the interacted agents representing scientific, educational, social, cultural institutions (their subdivisions and creative teams) interested in the development of the educational system, industrial enterprises.

Research and educational network development principles.
Conceptual unity, consistency, integrity, continuity and advanced development of the educational environment, completeness of the innovation cycle, openness, free self-determination and independence, growing, integration of different types of resources in the course of subjects interaction, information richness.

Functions: analytical, expert, control and diagnostic, research, technological, organizational and activity-related, educational, consulting, integrative, reflective.

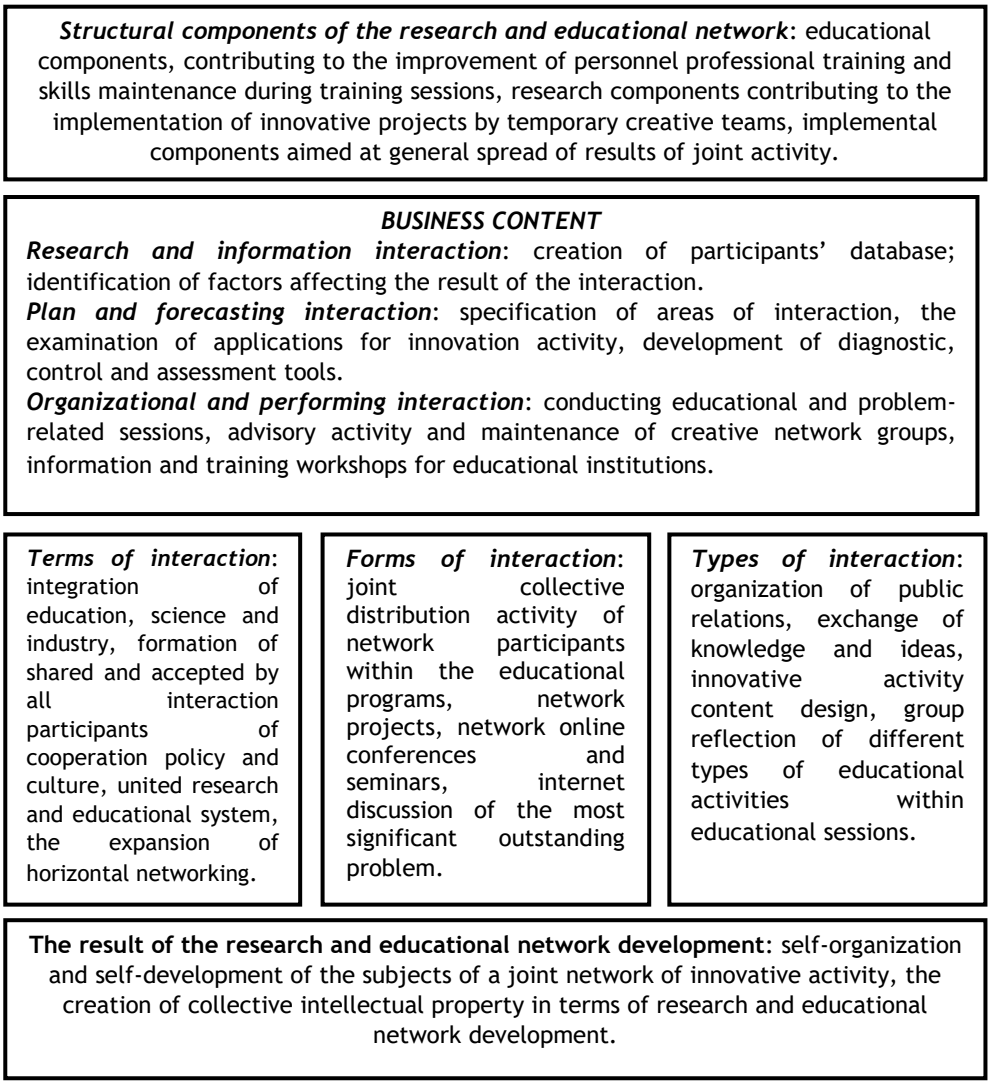

Figure 1. Organizational and pedagogical management model of the research and educational network development of the scientific and educational institutions of different types and kinds and industrial enterprises

Stages of model integration

The integration of this model suggests the following stages of experimental work.

The diagnostic stage (first stage) provided for the identification of the general field of network integration development, definition of potential subjects of interaction, correlation of their mission and development directions to the actual research and educational network. The innovative potential of the possible network interaction participants under basic and specific criteria and statistical processing of survey results were assessed as well.

Among *basic criteria* for the assessment of possible participation of educational, research institutions and industrial enterprises in the research and educational network should be specifically mentioned the unity of objectives and strategies as a basis for the integration, possible alignment of participants competencies and convergence of resources, the reduction of costs associated with the duplication of functions, possible cooperation related to the implementation of innovative projects of participating organizations, the availability of previously implemented joint projects.

The special analysis criteria of the *educational institutions* willing to join the research and educational network, we mentioned the existence of educational programs and technologies, professional personnel, external relations, experience in personnel training and retraining in the designated direction and recognition by educational community etc. relevant for the area of the research and educational network activity.

Specific criteria for the assessment of *scientific organizations'* abilities included the existence of research areas corresponding to the area of the research and educational network activity, intellectual properties, monographs, articles published in scientific periodicals adjusted by foreign and Russian organizations, professional personnel, scientific laboratories, research and educational centres of other elements of the innovation infrastructure, experience in carrying out research-and-development activity on the topic being of interest to network participants, recognition by the academic community, etc.

Special criteria for the assessment of opportunities of *industrial enterprises* include first of all the need for internal investigations in the directions of research and educational network, the availability of necessary innovative infrastructure, experience in interaction with educational institutions.

On the basis of the stage results it was decided whether the work of research and educational network in the selected areas is expedient or not, and the priority directions of its activity, the list of participants and developed operation cards of innovative activity of interaction participants were determined.

The second stage was focused on the development of the networking content on the basis of the identified structure of participants and suggests the following:

- Definition of the growth directions, general strategic targets and objectives on the basis of interaction results forecasting (growth areas, possible transformations, risks);

- Definition of the specific innovation projects implemented within the proposed areas of activities, identifying the competencies and resources of interaction subjects required for their implementation;

- Development of organizational and pedagogical model of the research and educational network, and organizational and managerial conditions for its operation;

- Development of the regulatory framework governing the interaction of subjects within the network.

The third stage establishes the main targets and objectives, ways of cooperation and coordination of activity of the specific subjects of interaction ensuring the mechanism for the implementation of innovative projects. The

collaborative mechanisms of the interaction subjects are defined within the framework of innovative projects on specific areas, taking into account the implementation time, resource and competence-based potential of the participants. This stage means the systematic assessment of the results of separate projects implementation and the efficiency of network interaction in general, definition of changes in the innovative potential of participants in order to develop the ways of further network development.

The final stage is aimed at the improvement of the processes of the research and educational network development management based on the monitoring of the implementation of projects performance indicators, adjustments of cooperation areas taking into account the development strategies of each of the interaction participants.

Integrative basis for association of research and educational network participants is the consulting support of project activity on the formation of the content and organization of education in the universe of innovation-oriented culture, exposed in all forms of advisory services during the design of development programs, research and managerial projects, improvement of the methodological culture of the participants in the course of educational sessions of research and educational network.

Due to the fact that the network interaction of the research and educational network participants provides for a long-term cooperation, its effectiveness depends largely on the stability of the subjects of this interaction. To assess the stability of the network interaction and research, the methodology adapted to the targets and objectives of the development of research and educational network was used, which was based on the assessment of changes in the network interaction stability (Makoveeva, 2012). Figure 2 shows that during the period of research and educational network development in 2008-2014 there was a tendency to strengthen the relations between the interaction participants.

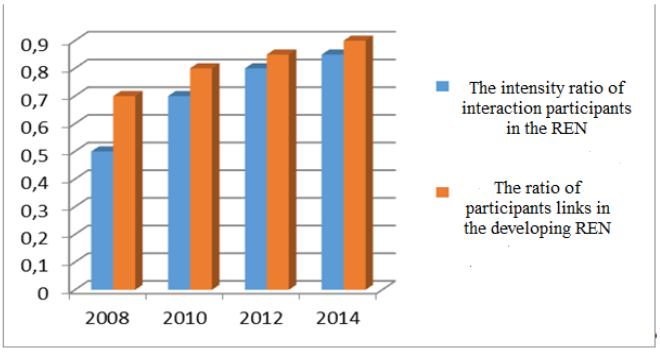

Figure 2. The dynamics of research and educational network (REN) stability in 2008-2014.

Totally more than 70 educational, research institutions and industrial enterprises, over 1500 teachers of educational organizations participating in the interaction took part in the study in different periods of the research and educational network development. The development of internal information space of research and educational network contributed to the achievement of scientific and practical results of cooperation, ensuring the creation of collective

intellectual property and an increase in the external effect (Fedorov & Davydova, 2014).

Over the last few years, with the support of teaching staff of the research and educational network more than 600 public events on the issues of research and educational network were held, the interaction participants actively participated in the presentation of their own activity results during scientific and practical conferences and various forums. Innovative activity of research and educational network was awarded the "Pearl of Russian Education" Grand Prix of the 15th All-Russian Professional Competition "Innovation in Education" and 2 certificates of the Russian Agency for Patents and Trademarks of the Russian Federation on databases registration were issued.

Discussions

The results of comprehensive studies of contemporary social and cultural environment make it possible to certify the formation of a new image of the world – open, complex and continuously changing world (Castells, 2000). This situation is interpreted by modern researchers as the transition from classical to neoclassical and in some areas - to post-neoclassical worldview, namely from objects to relationships between objects, from determinations cult to the uncertainty and ambiguity, from uniqueness to multiplicity of interpretations, from totality to self-organization. P.V. Malinovsky (2004) noted in his works that "... an important vector of development in the modern world moving toward post-industrial society, are new ways of organizing social activity of people and co-organization technologies as they have the synergistic effect from the interaction, expressed in the evolution of organizational forms of joint activities: co-interacting, co-individual, co-coherent and co-creative" (Malinovsky, 2004). In recent years, the methodological works have appeared confirming that the role of the main mechanism in the development of innovative processes in the education changes to the cooperation in its highest, collaborative forms when it is associated with a continuous coordination of participants' actions, providing the synergy of their joint efforts (Fedorov & Davydova, 2013).

It is known that network partnerships based on the integration establish the following progress factors:

- Lack of the physical restrictions for growth;
- Fast diffusion and assimilation of knowledge;
- Creation of new knowledge and new tools;
- Ensuring own identity of network partnership;
- Co-management of cooperative knowledge;
- Maximum opportunities for acquisition of the most innovative valuable tacit (implicit) knowledge, which cannot be formalized and acquired traditionally (broadcasting, codification, digitizing, storage) (Silkina & Vaganova, 2013).

Thus, the main objectives of network interaction as an important mechanism for the integration of the subjects of the educational, scientific and research and production activity is the development of the intellectual capital of

the interaction subjects, training of specialists qualified in the field of generation and spread of new knowledge.

The principal difference of the research and educational network described in this paper from other types of network interaction, considered by Russian and foreign authors, it is that a "corporate architecture" of the network is projected in the direction from concepts and development ideas of specific educational institutions and industrial enterprises to the objectives and further to the operating model of the research and educational network. This approach allows for the solution of specific development problems of the organizations and enterprises, and gives a stable basis for the network functioning on the basis of the system interaction of collective pedagogical practices of different educational institutions. A specific feature of the development goals of the research and educational network is the harmonization of the needs and interests of the subjects of educational, scientific and research and production activities.

Interaction mechanisms between the subjects of the research and educational network, namely between specific organizations, define the principles of self-regulation. Each participant of the network interaction has certain functionality and content, which, according to the law of synergy, are strengthened in the network interaction. The basis for the functioning of the research and educational networks are specific projects ("temporary links"), created on the basis of network interaction at the time of solving problems being faced by the participants of the research and educational network (Davydova, 2010). Thus, the participants are unique nodes (actors) of the network, which interact on the following issues: creation of joint programs, organization of distributed learning, implementation of research project, research and practical conference on the problem, etc. In this regard, the connections and subordinations of network nodes may vary depending on the problem being addressed. The solution of specific problem will be accompanied by changes in the mechanisms of connections between the network elements: every new problem can lead to the formation of a temporary hierarchical structure or certain subordination. This methodology explains the functioning principles of the created distributed structure of the network interaction and defines the functionality of network participants. Within the framework of provided organizational and pedagogical model the network interaction is organized primarily on the basis of information and communication technologies (soft - power - technology) (Fedorov & Davydova, 2014). The choice of such approach is based on existing experience of networking application when creating and using websites, portals, telecommunication networks, etc. The elementary unit of network interaction shall be the educational, scientific organization or enterprise which implement the innovative educational programs, have experience of research, experimental and project activities of the participants, build their own conceptual model of the innovative behaviour, have positive status in the surrounding society, possess a certain investment prospects and oriented at advanced generation approaches and technologies and instrumental support of a new type of educational content (Dorozhkin & Davydova, 2013).

Among important conditions and network interaction management mechanisms special should be stressed the following:

- Conversion of network operation general purposes and problems of network interaction participants;

- Positioning of network participants activities with regard to the set objectives;

- Definition of the status of the network interaction subject with regard to the objectives and problems set for the subject and the network;

- Definition of the methods of bringing the interaction subjects in conformity with the set objectives and problems by changing the conditions and mechanisms of resource support of their activities;

- Formation and adoption of collective management decisions.

The selection of priority directions of the research and educational network for the medium-term period is determined by the results of the independent examination of innovative projects of the educational institutions, conducted in

the form of public defence and the discussions in the course of network training sessions (Dorozhkin & Davydova, 2013).

The following is recognized as the selection criterion:

- Common interest of the network interaction participants in the area development;

- Focus on solving urgent content-related and technological problems of regional education development;

- Theoretical, practical and social importance of innovations for the development of networking as a whole;

- Contribution to strengthening the positions of the research and educational network in the regional educational space;

- Availability of staffing, stimulation of growth of the intellectual potential of the educational institutions;

- Level of information support;

- Availability of organizational and management mechanisms of the project within the network;

- Level of risk.

The priority selection procedure is constructed in a way allowing to take into account the existing connections between the directions of the research and educational network, as well as not to miss new development directions of the educational system of the country and the region. It has been established that drive of educational institutions to self-development and self-organization contribute to the creation and development of the research and educational network in the education system. It was determined that in order to make the system to be self-organizing, and as a result progressively developing, the system should meet the following requirements:

- The system must be open.

- The processes occurring in the system, must be corporate, i.e., the actions of its components should be consistent with each other.

- The system must be dynamic, in other words, to be away from the equilibrium condition.

Therefore, the need for the development of corporate processes initiates the transition towards the extension of cooperation of open educational systems in terms of the network interaction. In this regard, the basic conditions for the development of effective network interaction in the developing research and educational network shall include:

- Understanding of the unique character of the educational organizations – participants of the research and educational network;

- Availability of expressed pedagogical subjectivity;

- Readiness of the interaction participants to describe and to present their subjective content;

- Readiness of the network participants to make efforts to present their own subjectivity;

- Availability of network interaction technical opportunities and availability of navigation systems;

- Dialogical design and construction of joint forms of activity.

Therefore, the successful educational practice within the implementation of the organizational and pedagogical model of the research and educational network, as opposed to previous studies, evidences that the effect of joint activity is always higher than individual efforts due to the increase in the cooperation potential, expansion of relationships, and specific intellectual products and collective owners are formed in the research and educational network.

Conclusion

Thus, in the context of the research and educational network due to the non-linear relations the co-evolution processes are developing successfully and characterized by higher overall participants development rate in the course of interaction than before the association.

The sustainable development of network interaction is ensured by the following integration advantages:

- Network interaction enables complex solution of challenging pedagogical problems which cannot be solved by specific organizations.

- Interaction participants distinguish different solutions of common problem on the part of interaction colleagues that allows them to understand the advantages and disadvantages, as well as “to strengthen” the author’s own position.

- Exchange of resources between the network participants make each participant more stable and more mobile, able to solve complex system problems by creating systems projects in conjunction “Education – Business – Society”.

In general, during the development of the research and educational network the following system-wide tasks shall be solved:

1. Assistance in the development of innovation infrastructure of the network interaction, providing the technological passage for innovations through creation of responsibility centres in the basic network organizations, research and creative laboratories on topical issues of education, temporary creative groups on the issues, centres for collective use of networking development.

2. More efficient application of integration potential of the research and educational network by creating conditions for the presentation of results of the innovation activity of the interaction subjects during the inter-regional, federal and international innovation exhibitions, showrooms, conferences, forums, seminars, innovative projects of federal target programs, grants competition of federal and international funds, the formation of electronic databases of interaction subjects, etc.

3. The development of the information environment and improving the innovation culture of the network interaction participants due to wide dissemination of positive results of the innovation activity of the research and educational network participants in the central and regional press, assistance in providing the information support to the interaction subjects, consistent information of the public and of the interested persons on the policy conducted in the field of innovation development.

At the same time, among the obvious problems of management development of the research and educational network we would like to emphasize the following:

- Inadequate technical and technological support of network interaction;

- Difficulties with the release of new pedagogical positions with regard to the network interaction participants;

- Unsolved issues regarding the search of mechanisms for promoting innovative educational programs and support for network group activity from the municipal and regional authorities.

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