UDC 378

N. N. Davydova, Cand. Sc. (Tech.), Assoc. Prof.,
E. M. Dorozhkin, Dr. Sc. (Ed.), Prof.,
V. A. Fedorov, Dr. Sc. (Ed.), Prof.

Russian State Vocational Pedagogical University, Yekaterinburg, Russia, e-mail: fedorov1950@gmail.com

INNOVATIVE PROCESS DEVELOPMENT IN THE FRAMEWORK OF SCIENTIFIC EDUCATIONAL NETWORK: MANAGEMENT MODEL

Н. М. Давидова, канд. техн. наук, доц.,
Є. М. Дорожкін, д-р пед. наук, проф.,
В. А. Федоров, д-р пед. наук, проф.

ФГАОУ ВПО Російський державний професійно-педагогічний університет, м. Єкатеринбург, РФ, e-mail: fedorov1950@gmail.com

РОЗВИТОК ІННОВАЦІЙНИХ ПРОЦЕСІВ В УМОВАХ НАУКОВО-ОСВІТНЬОЇ МЕРЕЖІ: МОДЕЛЬ УПРАВЛІННЯ

Purpose. Research of the potential of developing innovative process management in educational institutions and industrial enterprises in conditions of the scientific educational networking.

Methodology. The theoretical basis of the innovative process development management of organizations involved in the scientific educational network is founded on the synthesis of such approaches as network interaction theory, anthropological approach to the educational innovation management as well as systematic, functional and synergetic approaches.

Findings. It has been established that management and development of the scientific educational network envisages a certain sequence of actions that makes provisions for the system-defined self-development of the network participants. Basic features of the innovative policy of scientific educational development have been described.

A set of criteria for the efficiency assessment of the network innovative projects have been presented. It has been demonstrated that the primary outcome of the network interaction is not only the scientific innovative impact enhancing the efficiency and quality of education but the process of the network interaction as such promoting the creation of new network cells that represent the content-based expansion of the scientific educational network.

Originality. A function-based structural model for managing the network participants' innovative activities has been designed. The network-based innovative process development has been specified in terms of algorithm including such elements as conceptualization, planning development and functioning and laying out the prospective areas of activities, designing concrete innovative projects, managing the member subjects' interaction.

Practical value. Application of the achieved results in educational practices makes it possible to enhance the innovative development efficiency of the establishments involved in networking.

Keywords: *scientific educational network, effective development of the network-based scientific educational innovative projects*

Introduction. One of the cardinal trends in professional education studies today is linked to the long-standing problem of quick and effective professional training. This growing concern reflects the basic principles stated by the Strategy of national development that set forth the human resource and innovative economic development as major guidelines for the existing system and theory of vocational education.

In this light, the main object of effective development is the creation of the national innovative system

that lays special emphasis on the innovation technologies and high-grade technology production. Combination of these target objectives is based on the common ground of vocational education that serves both as a source and a means of skilled personnel supply for the innovative and state-of-the-art enterprises. Consequently, innovative transformations of the current vocational education system are required.

Viewed from this angle the task of theoretical and technological elaboration of basics for setting up and disseminating innovations in the sphere of vocational preparation for innovative and modernized enterprises becomes a topical issue charged with social, scientific and pragmatic significance.

Analysis of the recent achievements. Contemporary social medium is subject to global transformation leading to the alteration of the level features of its systematic development and providing new opportunities and conditions for accomplishing the system self-organization as well as solving the problem of self-government.

The former hierarchical arrangement based on the personal monopolistic decisions used to rely on conditions of relative stability. The global character of modern competition makes it open, powerful and innovative-based to such an extent that cooperation comes to the fore as a decisive factor of the economic system development. At this level, cooperation implies its superior form of collaboration that requires constant coordination of the participants' activities to ensure the joint synergy of their efforts.

The existence of "dense network of cooperation" in the world economy has been identified by G. Richardson in the second half of the 20th century, which is defined as completed and interconnected clusters, groups and alliances, where the cooperation is presented fully and formalized.

Mutual cooperation of enterprises was speedily evolving following a similar value-oriented logic and in the forefront of this process were partnerships in research, development and dissemination of innovative products. Participants of such network projects build up a shared vision of adaptation measures to deal with the highly variable environment [1, 2].

Due to the common vision networking partners are capable to take more effective decisions (a collective self-government mechanism) as well as join their efforts efficiently to achieve new high quality general benefits (a mechanism of collective creation of innovations). It should be noted that this common vision is constantly modified by way of mutual harmonization process that allows generating innovations on a regular basis [3, 4].

The advantages of the networking principle of interaction are first and foremost the information transparency, adaptability to the ever changing market conditions, its inherent potential to integrate the innovative component in the network of the interacting parties. These advantages may be helpful in solving the problem stated above, namely, the management of innovative development in the sphere of vocational training.

Some of the major factors conducive to the formation and development of network partnerships in the sphere of vocational training are:

- appearance of new mechanisms and processes in the sphere of knowledge management in education;
- transformation of educational establishments as a result of the evolution and reconstruction of the system of education;
- forthcoming of the new methods of presentation and actualization of the educational content;
- formation of the students' competences on the basis of the activity-induced educational needs models of individual learners;
- emergence of the new innovative patterns of educational activities and management of information interaction;
- informatization of education and the advance of information, communication and telecommunication technologies that provide a common information-based educational environment;
- dynamic introduction of distance learning technologies.

A number of scholars [5, 6] stick to the point that educational systems today have given rise to three major types of networks:

- networks as a totality of educational institutions to carry out the national function of providing the population with uniform universal and accessible education;
- networks whose appearance is stipulated by the diversity of educational programs, their realization by different educational institutions and the variety of links among them. These networks are similar to the Internet type of interaction when links and communications appear as a reaction to the occasional type of content;
- networks that generate new types of human relationships which are called socially functional or contact relationships. In the system of education this type of networking is represented by research institutions, scientific and educational networks that unite scientists, educationalists and business people.

Presentation of the main research. The article presents the results of development and investigation of the innovation process management model implemented in conditions of the scientific educational network established by the Ural division of the Russian Academy of Education and approbated by the Russian state vocational pedagogical university. Launched in 2006, the project uniting various institutions of general and vocational education and industrial enterprises involved in education, has demonstrated the capability to gain certain competitive advantages for its partners due to the competent innovative, transparent and unlimited virtual communication.

The scientific educational network is defined by the authors as "a dynamic multitude of interrelated agents representing research, educational, social and cultural institutions (their departments, creative teams) as well as innovative infrastructure elements and industrial enterprises concerned with education development. This network functions as a variety of virtual organiza-

tion and carries out innovative projects in education. Realization of projects by the network is marked by a high level of goal coordination and integration of various resources, all of which is achieved by establishing the internal information network medium that consequently leads to the creation of common intellectual property products in the sphere of education thus expanding the external impact" [7].

An important spin-off of the network in question is the appearance of the net community involved in net communication that promotes achievement of assigned educational tasks in meeting both individual and social needs of higher quality and efficiency of education. Generally speaking, the innovative policy of the scientific educational network can be represented summarily by the three main elements:

- setting objectives and tasks of innovative development;
- elaborating efficient methods and means to achieve assigned tasks;
- selecting participants capable of achieving the desired innovative results [8].

Speaking of the strategy of the scientific educational network development that guarantees the innovative character of the network subjects' communication, the following basic requirements should be observed:

- subordination to the primary goal of corporate development;
- focus on the results of implementing new educational technologies;
- scientific validity, application of modern research methodology;
- measurability in terms of concrete quality rating;
- attainability of planned indicators considering external challenges and threats;
- flexibility or the ability to modify parameters on the score of external and internal environment changes;
- concurrence of goals, achieved and planned ones, when realization of the former sets the framework for the successful fulfillment of the prospective ones.

The structural functional model of managing the innovative process development in conditions of scientific educational network is presented in Figure.

Proceeding from the cybernetic theoretical principles, we can deduce that the management system of innovative establishments and enterprises of the network consists of the controlling and controlled subsystems [9]. The controlling subsystem of the model is represented by the management center of the scientific educational network activities. It delivers the following functions:

- goal-setting;
- marketing research;
- planning (strategic, tactical, operational);
- management of innovative activities;
- offering incentives for the network participants;
- record-keeping and function controlling;
- analysis and regulation of the running activities.

This center represents a holistic cybernetic program system functioning as the innovative process integrator that provides process formalization in accordance with the inherent hierarchy of the integrated information environment on separate levels of the scientific educational network attuned to the signals coming from the external information environment. The necessity for setting up this sort of center is stipulated by the following factors:

1. The absence of the uniform information system for managing innovative process implementation in the scientific educational network reduces the performance efficiency of its subjects due to the problems caused by the attempts to integrate internal processes run by separate institutions into a holistic system.

2. Progressive growth of the bulk information scope, containing the vital data for the project implementation, and diverse data bases stipulate the necessity of managing this information amplitude.

3. The united and integral character of the information processes implies uniform tools for their management, which, consequently, results in the reduction of managerial costs due to the uniform framework of integrated information environment.

The portal's performance capabilities make it possible to keep track of the following stages in the "life cycle" of the innovative projects in action.

Stage one of any innovative project run by the scientific educational network involves goal-setting, marketing research and planning. At this point the central tasks of the given project are specified, the project participants are selected (the project's creative team is set up), its scientific scope and necessary resources are estimated.

Stage two begins with resource consolidation required to solve the assigned tasks, as well as setting up the project team, involving the research, computer and intellectual potential of the staff. It is this stage that creates the intellectual foundation of the project and ensures efficient performance and use of resources.

The next stage generates innovative processes in the management center's internal environment that allow realizing tasks and goals set for each of the projects. At this point monitoring of the network performance management should not be underestimated in order to achieve goals set by each individual project in the network system.

Setting medium-term priorities in the scientific educational network activities is determined by the results of innovative educational projects assessment carried out by an independent expert appraisal [8]. Selection of these priorities is based on the following factors:

1. Theoretical, practical and social significance of the innovations for the network interaction development as a whole.

2. Focus on solving the topical problems of content and technological development.

3. Promotion of strong and sustainable position of the scientific educational network in the region.

4. Human resource availability, stimulation of the intellectual potential growth in institutions and enterprises.

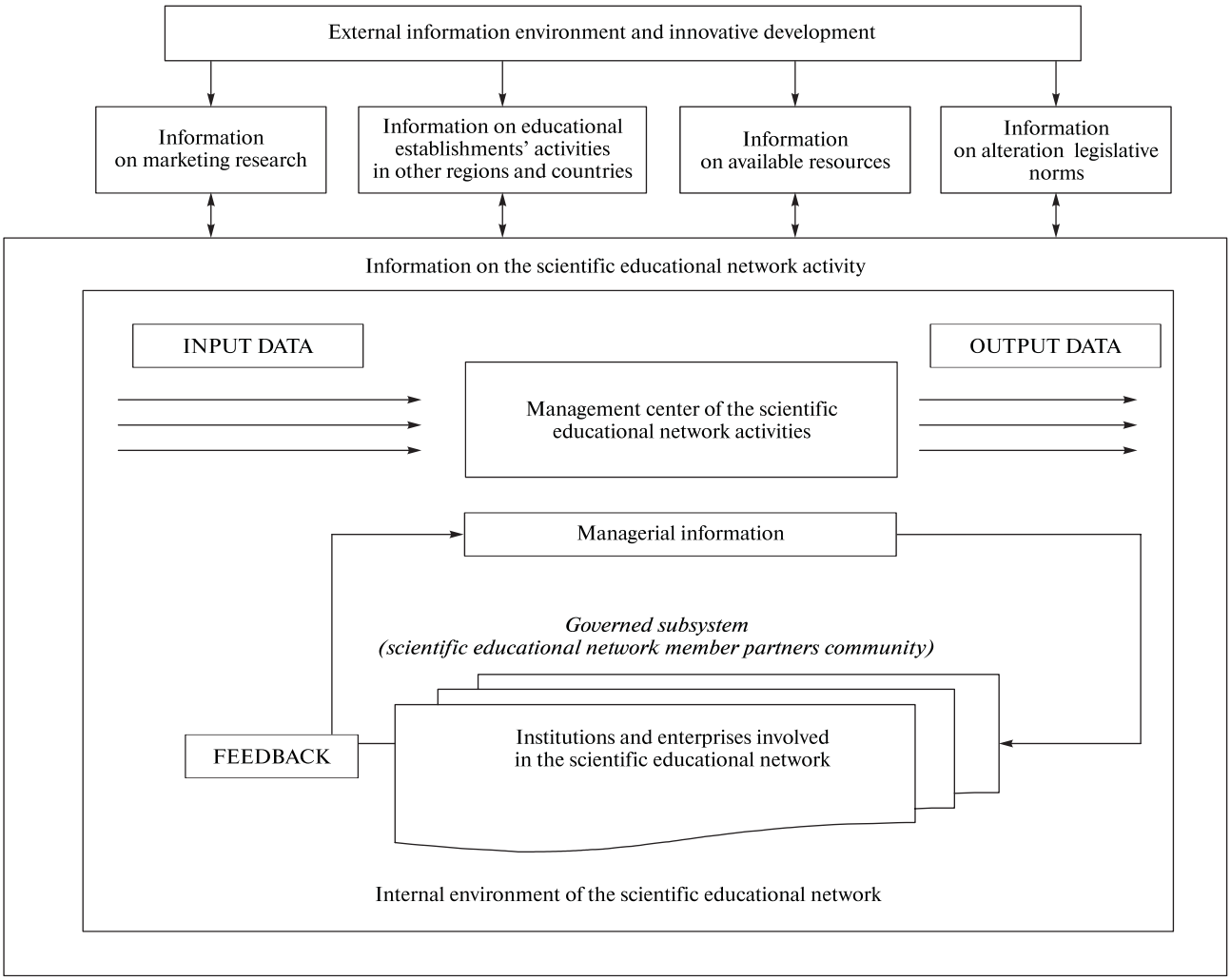

Fig. Structural functional model of innovative process management in the scientific educational network

5. The degree of informational support.

6. Existence of managing and controlling mechanisms in specific projects in the net framework.

7. Risk level.

Distribution and streamlining of the network partners enable them to determine the degree of each member institution's responsibility in the innovative project design and identify specific responsibility zones that include:

1. Organization of generating and selecting innovative development products.

2. Keeping track of the strategic innovative guidelines in network interaction.

3. Enhancement of the professional and creative activity of the network member parties.

4. Methodological supervision of the innovative projects implementation.

5. Consideration and preparation of the applications of potential partners for approval by the network Academic Council.

6. Revealing the positive and negative deviations from the accepted guidelines of innovative development.

Scientific supervision of the network interaction content is carried out by the network Academic Council, including representatives of research organizations and vocational education institutions.

Continual integration of internal innovative processes and detailed examination of this integration and its constituent parts as a synergetic system by the scientific educational network Management Center create favorable conditions for the participants' self-development during the study sessions, workshops, seminars, panels and theoretically-based practical conferences of different rank, held by the member partners of the scientific educational network community.

The key principles of innovative activity development in the scientific educational network institutions are:

- self-development of the member parties acting as a collective subject of the interaction, involving both instruction and self-study;
- implementation of measures to develop high standards of organizational culture;
- setting up horizontal management structures on the basis of self-governed temporary creative teams that are delegated a number of responsibilities;
- increasing support of adequate incentives to motivate the subjects' educational activity;
- enhancing the information culture of the participants including their ability for goal-directed process-

ing of the information provided by the network and using adequate information technologies to extract it;

- special set of criteria has been worked out for the assessment of the scientific educational network productivity and effectiveness. These criteria make it possible to monitor innovative process transformations, caused by the network interaction in individual institutions that in the long run determine the innovative policy both of the network on the whole and its individual members, in particular;

- the "unit of measurement" here is the participant and not the isolated elements of the interaction;

- the transformations are presumed as a new alternate solution of a topical pedagogical or pedagogical management problem;

- the transformation process itself is closely linked to the relevant theoretical and research project activity. The monitoring of joint projects in the frame of the scientific educational network is done by means of a file exchange folder which is installed in the internet portal network.

Review of different standpoints on the efficiency assessment and existent monitoring systems leads to the conclusion that though they offer an extensive list of indices, the monitoring techniques they suggest rarely contain concrete instructions on how to estimate the results and efficiency of the interrelated subjects' interaction proper.

Therefore, specific criteria for the result and efficiency assessment of the project members have been worked out (Table 1).

Self-diagnosis of the academic staff of educational institutions in relation to their level of proficiency in network innovative activities in which 320 respondents from 29 educational institutions involved in networking took part at different stages of the described model development, showed positive results in the dynamics of professional growth connected with their performance in the innovative activities (Table 2). Comparison of average indices of the given level with the indices at all levels of research and experimental activity demonstrated that the significance level of t-criterion according to Student was within $p < 0.05$ limits.

Conclusions. The proposed structural functional model of innovative activities management for the participants of a scientific educational network makes it possible to provide exchange of all sorts of resources as well as ensure sustainable expansion of the participants' cooperation.

This sort of involvement enables individual participants not only to realize their strengths and weaknesses, but also assert their "authorship" position in the course of the interaction and solve complex systematic tasks by designing joint projects in the close liaison of "general education cum vocational education cum corporate training in industrial enterprises".

Table 1

Criteria for the result and efficiency assessment of the project members' interaction in conditions of the of scientific educational network development

<table>
<tr><td colspan="2">Criteria for the result assessment of the network subjects' interaction</td><td>Criteria for the efficiency assessment of the network subjects' interaction</td></tr>
<tr><td colspan="2">Scientific result</td><td>Content-based activity impact</td></tr>
<tr><td>Quality parameters
• Topicality
• Novelty
• Theoretical significance
• Proposal efficiency
• Eligibility for implementation</td><td>Quantity parameters
• The number and level of publications
• The number of granted scientific degrees and finished dissertations ready for the defence
• Participation in grant activities, competitions and scientific practical conferences of various ranks</td><td>• Development of concept-based activities of the interaction subjects
• Implementation of the scientific supervision program for the innovative activities</td></tr>
<tr><td colspan="2">Methodological efficiency
• The number of institutions involved in the dissemination model of the subjects' innovative activities results
• Quantity indicators of methodological activities in various forms (conferences, workshops, creative presentations, round tables, consultations, etc.)
• Existence and implementation of their own professional development programs by the institutions involved in the network</td><td>Educational efficiency
• Assimilation of methodological and technological skills by the network participants in order to master the technique of project implementation in their practical educational experience</td></tr>
<tr><td colspan="2">Social impact
• Availability of the interaction subjects' innovative experience to the pedagogical community at large
• The range of network social partnership</td><td>Sustainability of the network subjects' interaction
• Correlation of the current network links and their number stated at the starting point
• Correlation of the interaction subjects' number in specific areas of cooperation and the total number of network participants
• Correlation of the number of implemented projects and those registered at the projecting phase, etc.</td></tr>
</table>

Table 2

The level of network members' proficiency in innovative project activities

Year	Indicator meanings of the network participants' preparation for innovative activities (points)			Mean score
	Scientific theoretical preparation	Scientific methodological preparation	Psychoeducational preparation	
2007	63	61	53	59
2011	75	76	65	72
2014	82	81	78	81

The major principles of the innovative process development of the member institutions involved in the scientific educational network include a systematic self-development of the participants of the interaction by way of getting instructions and doing self-study as well as setting up horizontal management structures on the basis of temporary self-governed creative teams with a number of responsibilities delegated to them.

Criteria developed for the assessment of the network interaction efficiency affords ground for diagnosing the network interaction challenges, identifying their nature, providing appropriate managerial measures to deal with them and defining prospective guidelines for the scientific educational network development.

The cardinal result of the network interaction – alongside its scientific innovative impact that enhances the efficiency and quality of education – is the network process proper, its expansion and profound content evoked by the interaction, the creation of new network cells that represent the content-based expansion of the scientific educational network.

Робота виконана за фінансової підтримки Міністерства освіти та науки РФ (проект № 2014/393).

References/Список літератури

1. Greve, H., 2005. Inter-organizational learning and heterogeneous social structure. *Organization Studies*, No. 26(7), pp. 1025–1047. DOI: 10.1177/0170840605053539.

2. Felin, T. and Hesterley, W., 2007. The knowledge-based view, nested heterogeneity, and new value creation: Philosophical considerations on the locus of knowledge. *Academy of Management* Review, No. 32(1), pp. 195–218.

3. Dyer, J. and Hatch, N., 2006. Relation-specific capabilities and barriers to knowledge transfers:creating advantage through network relationships. *Strategic Management Journal*, No. 27(8), pp. 701–719. DOI: 10.1002/smj.543.

4. Provan, K., Fish, A. and Sydow, J., 2007. Interorganizational Networks at the Network Level: A Review of the Empirical Literature on Whole Networks'. *Journal of Management*, Vol. 33, No. 3, pp. 479–516.

5. Dmitrieva, E.A., 2015. Concerning the networking interaction experience of teachers and students of pedagogical university. *The Education and science journal*, No. 6, pp. 77–88. DOI:10.17853/1994-5639-2015-6-77-88

Дмитриева Е. А. Из опыта обучения сетевому взаимодействию педагогов и студентов педагогического ВУЗа / Е. А. Дмитриева // Образование и наука. – 2015. – № 6. – С. 77–88. DOI: 10.17853/1994-5639-2015-6-77-88

6. Silkina, N.V. and Vaganova, N.J., 2015. Special features of the educational environment through the net interaction of education and production. *The education and science journal*, No. 6, pp. 63–76. DOI: 10.17853/1994-5639-2015-6-63-76.

Силкина Н. В. Особенности образовательной среды в сетевом взаимодействии образовательной организации с производством / Н. В. Силкина, Н.О.Ваганова // Образование и наука. – 2015. – № 6. – С. 63–76. DOI: 10.17853/1994-5639-2015-6-63-76.

7. Fedorov, V.A. and Davydova, N.N., 2014. Control of the research and education network development in modern socio pedagogical conditions. *Naukovyi Visnyk Natsionalnoho Hirnychoho Universitetu*, No. 2, pp. 126–133.

Федоров В. А. Управление развитием научно-образовательной сети в современных социально-педагогических условиях / В. А. Федоров, Н. Н. Давыдова // Научный вестник Национального горного университета. – 2014. – № 2. – С. 126–133.

8. Davydova, N.N., 2013. Implementing the systematic synergetic approach in management practices related to the research and education network development. *The Education and science journal*, No. 7, pp. 67–84. DOI: 10.17853/1994-5639-2013-7-67-85.

Давыдова Н. Н. Реализация системно-синергетического подхода в практике управления развитием научно-образовательной сети / Н. Н. Давыдова // Образование и наука. – 2013. – № 7. – С. 66–84. DOI: 10.17853/1994-5639-2013-7-67-85.

9. Ackoff, R. and Emery, F., 2008. *On purposeful systems*. Moscow: LCI.

Акофф Р. О целеустремленных системах / Акофф Р., Эмери Ф. – М: ЛКИ, 2008. – 272 с.

Мета. Дослідження можливостей управління розвитком інноваційних процесів в освітніх організаціях та промислових підприємствах в умовах науково-освітньої мережі.

Методика. Теоретичний базис управління розвитком інноваційних процесів в організаціях в умовах науково-освітньої мережі грунтується на синтезі теорії мережевої взаємодії, антропологічного підходу до управління освітніми інноваціями; системного, функціонального та синергетичного підходів. Теоретичні методи: теоретико-методологічний аналіз, моделювання. Емпіричні: вивчення та узагальнення ефективного досвіду

застосування мережевого підходу, експеримент, включене спостереження, анкетування, експертна оцінка.

Результати. Встановлено, що організація та розвиток інноваційних процесів у науково-освітній мережі передбачає певну послідовність дій, що забезпечує системний саморозвиток учасників в умовах мережевої взаємодії. Описані основні елементи інноваційної політики науково-освітньої мережі. Представлено критеріальний комплекс, що визначає ефективність розвитку інноваційних проектів в умовах мережевої взаємодії. Показано, що ключовим результатом мережевої взаємодії, нарівні з науково-інноваційною результативністю, яка призводить до підвищення ефективності та якості освіти, є сам процес мережевої взаємодії, його обширність і народжувана у процесі цієї взаємодії змістовна глибина, зростання числа знов організованих вузлів як нових точок змістовного розширення науково-освітньої мережі.

Наукова новизна. Розроблена структурно-функціональна модель управління інноваційною діяльністю учасників науково-освітньої мережі. Уточнено алгоритм розвитку інноваційних процесів в умовах науково-освітньої мережі, що включає концептуалізацію, програмування процесу її функціонування та розвитку, планування напрямів діяльності, розроблення окремих інноваційних проектів, управління взаємодією суб'єктів.

Практична значимість. Використання отриманих результатів в освітній практиці дозволяє підвищити результативність інноваційного розвитку включених до мережевої взаємодії організацій.

Ключові слова: *науково-освітня мережа, ефективність розвитку інноваційних проектів в умовах науково-освітньої мережі*

Цель. Исследование возможностей управления развитием инновационных процессов в образовательных организациях и промышленных предприятиях в условиях научно-образовательной сети

Методика. Теоретический базис управления развитием инновационных процессов в организациях в условиях научно-образовательной сети основывается на синтезе теории сетевого взаимодействия, антропологического подхода к управлению образовательными инновациями; системного, функционального и синергетического подходов. Теоретические методы: теоретико-методологический анализ, моделирование. Эмпирические: исследование и обобщение эффективного опыта применения сетевого подхода, эксперимент, включенное наблюдение, анкетирование, экспертная оценка.

Результаты. Установлено, что организация и развитие инновационных процессов в научно-образовательной сети предусматривает определенную последовательность действий, обеспечивающую системное саморазвитие участников в условиях сетевого взаимодействия. Описаны основные элементы инновационной политики научно-образовательной сети. Представлен критериальный комплекс, определяющий эффективность развития инновационных проектов в условиях сетевого взаимодействия. Показано, что ключевым результатом сетевого взаимодействия, наравне с научно-инновационной результативностью, приводящей к повышению эффективности и качества образования, является сам процесс сетевого взаимодействия, его обширность и рождающаяся в процессе этого взаимодействия содержательная глубина, рост числа вновь организующихся узлов как новых точек содержательного расширения научно-образовательной сети.

Научная новизна. Разработана структурно-функциональная модель управления инновационной деятельностью участников научно-образовательной сети. Уточнен алгоритм развития инновационных процессов в условиях научно-образовательной сети, включающий концептуализацию, программирование процесса ее функционирования и развития, планирование направлений деятельности, разработку отдельных инновационных проектов, управление взаимодействием субъектов

Практическая значимость. Использование полученных результатов в образовательной практике позволяет повысить результативность инновационного развития включенных в сетевое взаимодействие организаций.

Ключевые слова: *научно-образовательная сеть, эффективность развития инновационных проектов в условиях научно-образовательной сети*

Рекомендовано до публікації докт. екон. наук О. Г. Мокроносовим. Дата надходження рукопису 31.07.15.