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**UNIVERSITY AS AN INTEGRATOR
IN THE KNOWLEDGE-BASED
SOCIETY**

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The progress in the functional integration of educational, research and innovation activities is one of the crucial factors in the development of the knowledge-based economy and society. The article below deals with the problems of functional integration of a major university with the institutes of the Russian Academy of Sciences, branch research centers, hi-tech enterprises and public authorities. As the scale of this activity grows, a special infrastructure needs to be developed at the university along with the awareness that entrepreneurial approach has to be introduced into the operation of the university. When discussing the specific forms of such integration, the experience of the Lobachevski State University of Nizhni Novgorod and its partners is widely used in the article.

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UNIVERSITY AS AN INTEGRATOR IN THE KNOWLEDGE-BASED SOCIETY

Knowledge Integrator

Francis Bacon's historical slogan "Knowledge itself is power" since the end of the 20th century has begun to acquire a new global social and economic meaning that reflects the changes in the priorities of the development of national economies. Nowadays, it is not the natural resources and the workers' hands that determine the true strength (competitiveness) of the modern society, rather, it is the resource that has become the symbol of the new stage in the development of the global socium. The strength of the modern society and of its economy is to a great extent determined by knowledge, in other words, by the nation's intellect.

Universities are the centres of reproduction of the society's intellectual potential. Their new social and economic role in the global society of knowledge is just being realized. There are two fundamental tasks that determine the new status of universities in the society and in the state. First, it is the task of providing mass higher education with the purpose of general intellectual development of the nation and achieving the best intellectual solution at each workplace and, second, the task of the knowledge transfer with the purpose of the prompt total introduction and dissemination of innovative technologies in diverse spheres of activity.

Certainly, universities are not unique public enterprises for producing and disseminating knowledge. Educational institutions of other levels, research institutes, industrial corporations (especially hi-tech companies), authorities, establishments of culture also generate new knowledge in their respective areas. However, at the centre of this activity there are universities as unique organisations that secure the reproduction of the intellectual elite, which then works in other branches producing knowledge.

The university in modern conditions acquires a new role, that of a *knowledge integrator* or an *information integrator* in the society of knowledge. An integrator is understood to be an organisation realizing the processes of interaction between parts of a complex system with the purpose of ensuring of its development. In this case, we are dealing with information interaction, which is understood as the processes of joint generation, exchange and transfer of knowledge. Universities become the leading participants and organisational intermediaries for cooperation between educational and scientific structures with industries, establishments of culture, and authorities. The purpose of cooperation is to join the efforts for solving interdisciplinary problems of education and science, and to implement innovation and commercialization activities.

As it performs the functions of an integrator, the university offers its own internal resources for organisational interaction, and also generates external organisational networks of information interaction. It should be emphasized that the function of the integrator not only implies a multitude of bilateral

interactions with different partner organisations, but also, first of all, affords mutual interaction opportunities to partner organisations on the intellectual basis of the university, which acts both as a participant, an intermediary, and as a catalyst for such interaction.

Let us draw some analogies to other integrators of complex social and economic systems. First of all, one should mention the state, which can play the role of the economic integrator in a system of regulated market economy [1]. Looking back at the Soviet past of Russia it is possible to identify the role of the party organisational structure as a power and ideology integrator that in a number of extreme situations helped to solve problems of interaction between very different types of organisations (scientific, educational, cultural, industrial etc.) through party organs.

At the new stage of the society's development, «the power of knowledge» is at the forefront of social life, and universities are indisputably the primary organs of such power.

European Agenda for the Universities

The European Union's policy pursued in the field of education and science is one of the telling proofs that the concept of a university as an information integrator is adequate to the realities of modern society. This policy finds its expression in two global processes, the Bologna process of transformation of educational systems and the process of intensification of knowledge transfer set by the Lisbon Agenda. The Bologna process (where Russia is a participant) with its idea of harmonisation of national educational systems reflects the need in mass education and labour mobility in the conditions of an acute shortage in Europe of highly skilled experts - first of all, research scientists. In April 2005, the Glasgow conference of the main association of Europe's universities, the European University Association (EUA), was held. Speaking at the conference, the President of the European Commission J.M. Barroso gave some figures. Europe needs 700 000 more researchers. In Japan, there are 9 researchers per 1000 persons employed, while for Europe this figure is only 6, he noted [2].

The Lisbon Agenda is a program of scientific and technical, economic and social development of the Old World aimed at helping it to catch up with USA and Japan by 2010. The Lisbon Agenda first of all sets the tasks of the European countries in expanding innovation activity. The key European mechanism of advanced technology transfer is constituted by the framework research and development programs (FP). Russian research teams, by the way, also have the right to participate in these programs [3] (FP6 is now drawing to its close and the basic parameters for FP7 have already been determined). Summarizing the results of the conference, the European University Association has adopted a declaration with a rather telling title: «Strong Universities for Strong Europe» (recall Bacon's slogan!). As the provisions of the declaration explicitly target universities at performing the functions of European economy's "locomotive" by implementing the tasks of information integrator, its text deserves a very extensive quotation [2]:

1. The Glasgow Declaration provides the basis for a continued high level policy dialogue between universities - in the broadest sense - and public authorities which was called for in Glasgow by Commission President Jose Manuel Barroso in order to secure, as one of Europe's top priorities, the future of Europe's universities.
2. The Glasgow Declaration sets out actions which will ensure that universities make their full contribution to building Europe as a major player in a global environment. This Action Agenda follows on from the work begun by EUA in Salamanca (2001) and in Graz (2003).
3. Europe needs strong and creative universities as key actors in shaping the European knowledge society through their commitment to wide participation and lifelong learning, and by their promotion of quality and excellence in teaching, learning, research and innovation activities.
4. This will be achieved by self-confident institutions able to determine their own development and to contribute to social, cultural and economic well-being at regional, national, European and global level.
5. Universities are committed to improving their governing structures and leadership competence so as to increase their efficiency and innovative capacity and to achieve their multiple missions.
6. Universities' multiple missions involve the creation, preservation, evaluation, dissemination and exploitation of knowledge. Strong universities require strong academic and social values that underlie their contributions to society. Universities share a commitment to the social underpinning of economic growth and the ethical dimensions of higher education and research.
7. Universities are developing differentiated missions and profiles to address the challenges of global competition while maintaining a commitment to access and social cohesion. Diversification and greater competition are balanced by inter-institutional cooperation based on a shared commitment to quality.
8. Inter-institutional cooperation has been the hallmark of Europe's universities and is increasingly important in a globalised and competitive environment. Universities acknowledge that European integration must be accompanied by strengthened international cooperation based on a community of interests.
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10. Universities have demonstrated the inextricable linkage between implementing the Bologna reforms and meeting the research and innovation goals of the Lisbon Agenda. These two policy agendas urgently need to be viewed together in order for each to be successful in the long term.
11. Recognising this common research and higher education agenda implies rethinking the role of governments in their relation to universities. Governments must emphasise trust and empowerment, provide incentives in order to support and steer the higher education sector and concentrate on a supervisory rather than a regulatory role.

12. The importance of investment in education, innovation and research in meeting the Lisbon goals, and the central role of universities, means that policy discussions between universities and national authorities should take place with governments as a whole as well as at individual ministerial level.

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22. Universities must exercise their own responsibilities for enhancing research and innovation through the optimal use of resources and the development of institutional research strategies. Their diverse profiles ensure that they are increasingly engaged in the research and innovation process, working with different partners.

23. Universities strongly support the establishment of the European Research Council (ERC) for the enhancement of the quality and excellence of European research and call on national governments and the EC to establish it rapidly within the Seventh Framework Programme. Following identified good practices in several European countries and in the Sixth Framework Programme, governments should be aware of the need to open up and coordinate national funding.

24. Universities accept that there is a tension between the necessary strengthening of research universities and the need to ensure resources for research-based teaching in all universities. Governments are called upon to recognise the particular role of universities as essential nodes in networks promoting innovation and transfer at regional level and to make the necessary financial support available to strengthen this process.

The above excerpts from the text of the Declaration are eloquent enough and need no special comments. However, one idea should be emphasized, which is present in this or that form as the main direction in the development of universities. Universities should be regarded as key links in the chain of interaction for advancing knowledge and innovation. Thus, it can be seen that the European agenda includes the task of creating strong universities that should act as knowledge integrators in the course of implementation of the Bologna process, the Lisbon Agenda, and other programs aimed at European integration for enhancing the competitiveness of the united Europe.

Knowledge Integrator in the Region The Experience of the University of Nizhni Novgorod

In Russian regions, universities get involved in the processes of supporting integration interactions in their respective territories by the very course of social and economic development. The best-known and most active integration process is the interaction between universities and research organisations, first of all, Russian Academy of Sciences (RAS) institutes [4]. As this process develops further, it begins to include wider functions by providing, with the use of the universities' potential, the interaction between research organisations (including research staff of universities) and industrial enterprises. Similar

interaction occurs with the public authorities and institutions of culture. Regional interaction networks of various profiles are being formed.

Let us illustrate the development of such integration processes using the example of UNN (Fig.1). Like in most universities, UNN faculties are composed of departments that have research laboratories. The university has a total of 132 departments and 160 laboratories. All of them are integrated in the research division whose size compares to a large research institute. Besides, there are 5 research institutes the university. At this stage, when quality education based on research is an important tool for the development of the university, profound integration of its faculties with university research institutes of the university becomes an important issue.

University departments and the departments (laboratories) of university research institutes are the basic form where the making and development of scientific and pedagogical schools takes place. In the final analysis, it is their scientific significance that determines the educational and research potential of the university. Therefore, when organizing the interaction between educational and research units one takes into account not only the creative nature of such teams, but also their leaders' special role. In this context, one of the main forms in the organisation of such interactions is to ensure the unity of management. In the framework of this approach, either the head of a university department is at the same time appointed/elected to serve as the head of a research unit of the university research institute, or the head of a research unit becomes at the same time head of a university department. As a result, in the absence of vertical subordination of the units in the university structure, their functional unity ("horizontal links") is ensured in terms of education and research. In fact, a collective body of university workers is formed whose members conduct research and educational work within a common field of studies and research.

This principle of unity of management is also effective in organizing interaction in the field of education and research with research units of branch research institutes and RAS research institutes. Notably, one of the forms of interaction with research structures that are external with respect to the university includes branches of university departments set up on their basis.

An important new activity area of UNN as a research university is intellectual property management, which includes the identification of the intellectual property objects, choosing the form of their legal protection and their effective utilization. To develop this relatively new (to universities) type of activity, (since the former experience of "patenting and introducing" of research results is ineffective in present conditions), the Innovation Technology Centre (ITC) was set up at UNN. The purpose of UNN ITC is to implement at the university "a green corridor" - from obtaining new knowledge to manufacturing new competitive products on its basis and bringing them forth to the market. The development in ITC of real-life practice of technology transfer of applied research results has already given rise to quite a number of successfully operating small enterprises engaged in high-technology manufacturing. Unfortunately, the existing Russian legislation complicates considerably the attraction of

investors for commercialisation of research results and limits the participation of universities in the establishment of small hi-tech enterprises.

The University of Nizhni Novgorod takes part in the “Start” program initiated by the Russian Ministry of Education and Science and the State Fund for promoting the development of small enterprises in scientific and engineering spheres. This program is aimed at revealing scientific and engineering research results that are promising from the point of view of their commercialization and at incubating small innovative enterprises that receive off-budget funding, including venture financing. UNN ITC performs the functions of a structure responsible for the organisation and realization of the “Start” program in the Volga Federal District, within the framework of which in 2004 more than 70 small innovative enterprises were created. Most of these enterprises develop their activities on the basis of hi-tech research results of universities and scientific organisations located in the Volga Federal District. To step up the efficiency of integrated measures in the introduction of intellectual property into circulation, as world experience shows, universities must be in the number of shareholders of small enterprises. This will contribute to increased sustainability of such enterprises at the early phases of their development and will make them more attractive to investors.

The University of Nizhni Novgorod and RAS institutes located in Nizhni Novgorod (see Fig.1) have been collaborating for many years in the field of education, research and technology transfer. To coordinate this collaboration, Nizhni Novgorod joint Study and Research Centre (SRC) of the university and RAS institutes was organised in 2001 (see Fig.2). The establishment of the centre was approved by the Minister of education of the Russian Federation, the President of RAS and the Governor of the Nizhni Novgorod region. This centre’s organisational and legal status is that of a simple company without legal identity of its own. The overall management of the joint SRC is effected by the coordination council that incorporates representatives of the university and RAS institutes on parity basis. Within the framework of the joint centre, new forms of educational and research cooperation have been developed, ensuring elite training of personnel in the interests of RAS and high-technology sectors. Research potential and material and technical resources of RAS institutes, faculties and research institutes of UNN are involved to provide such training.

At the RAS Institute of Applied Physics (IAP), the Advanced School of General and Applied Physics is functioning with the status of a UNN faculty (a base faculty; see Fig.1). It is a vivid example of close integration of research done at the Academy of Sciences level with higher education. Each student of this faculty, from his or her first year, has an IAP researcher for a personal tutor. General training is provided by the best teaching staff of many university faculties; specialization and special practicums on unique equipment are carried out by the researchers of IAP and of the RAS Institute of Physics of Microstructures. The high quality of such training is confirmed by many awards won every year by the students of this faculty in All-Russia Olympiads in physics and mathematics.

A somewhat different example is provided by the university base department (see Fig.1) of physics of solid-state nanostructures set up at the RAS Institute of Physics of Microstructures. At this department, a combined group of students of three faculties (Physics, Radiophysics and the Advanced School of General and Applied Physics) pursue their specialization. This specialization is provided by the teaching staff of all the three faculties and by the researchers of the RAS Institute of Physics of Microstructures and the RAS Institute of Applied Physics. Such approach allows to organise in an effective manner elite training in new fields of modern science and engineering. To support the specialization, the institutes of RAS have set up their base training and research laboratories at the faculties of Physics and Radiophysics.

Currently, 12 branches of UNN departments operate in a number of RAS institutes. In 2002-2004, 83 UNN graduates were hired for jobs in RAS institutes and in the university. More than forty staff members of RAS institutes, including 17 members and corresponding members of RAS, deliver lectures for graduate and post-graduate students of UNN. The university renders support to the implementation of educational components in the training of post-graduate students of RAS institutes. In the course of 2002-2004, nine international and eleven All-Russia conferences and schools for young scientists were held; the regional Olympiad for secondary school students "Future researchers" (in mathematics, physics, chemistry) is a regular event.

The Nizhni Novgorod joint Study and Research Centre is a recognised centre of appraisal in the training of research and scientific/pedagogical staff of the highest qualification for the system of education, science and industry. Seven out of fifteen doctoral councils at UNN comprise staff members of RAS institutes, and university professors work in four doctoral dissertation councils at RAS institutes. A number of UNN professors are members of scientific councils in each of the Nizhni Novgorod institutes of RAS, and three members of RAS participate in the work of the University's Academic council.

An important feature of the Nizhni Novgorod joint SRC is a well-established system of interaction between the academic (RAS) and university sectors of science. A significant part of research projects, programs and grants are carried out jointly by the scientists of UNN and of RAS institutes. Approximately 150 employees and post-graduate students of UNN work in RAS institutes, and more than 60 employees of academic institutes are engaged in research in university laboratories. For example, RAS researchers use the unique equipment for scanning probe microscopy at the UNN Research and Education Centre "Physics of Solid-State Nanostructures", established due to the joint program "Basic Research and Higher Education" of the Russian Ministry of Education and CRDF, a well-known American fund. On the other hand, UNN employees carry out a number of research projects at the shared use centres for analytical equipment at RAS institutes. These joint activities were supported in 2005 in the framework of the Federal R&D Target Program that provided the funds to set up the shared use centre "Wave and quantum technologies". This work is being performed jointly by the University and RAS research institutes located in Nizhni Novgorod.

The university attaches much attention to interaction with applied research institutes and enterprises of high-technology industries (see Fig.1). This kind of interaction is also exercised on the basis of comprehensive agreements providing for cooperation in the field of scientific research and personnel training. Branches of UNN departments are opened in partner organisations (which includes the development of specializations and realization of special practicums and practical works) and base laboratories of partner organisations are set up at UNN faculties. Such contracts exist with many research-and-production associations located in the Nizhni Novgorod region (Research Institute of Measuring Systems, research and production company “Salyut”, research and production company “Quartz”, research and production company "Polyot", etc.).

As practice shows, educational and scientific interaction of UNN with high-technology enterprises can be one of the major factors in the forming of the regional labour market in respective spheres of activity. As an example of such influence, let us briefly consider the experience of cooperation between UNN and Intel Corporation, which has rather large research-and-production laboratories and regional marketing structures in Nizhni Novgorod. The company whose Nizhni Novgorod divisions have demonstrated an appreciable trend to further growth, renders serious support to the university in the training of personnel in the field of information technologies (and in adjacent areas). This includes both the company's orders for scientific research and compensation-free transfer of expensive and effective equipment. For example, at the Faculty of Radiophysics, the company's base training and research laboratory for wireless technologies was organised, and at the Faculty of Computational Mathematics and Cybernetics, a similar laboratory in the field of information technologies. The company supports (by providing funds and prizes) students' and schoolchildren's competitions on informatics and computing held at the university. It also contributes (together with one of the local newspapers) to the positive professional orientation of the young people in this new important field of activity. One of the recent joint projects was a semester-long course in the field of modern information technologies for members of teaching staff of regional institutions of higher education (selected on a competitive basis) organised on the basis of the staff development faculty of UNN. This project under the title “Virtuoso” involving some staff members from Russian and Ukrainian universities is also financed by other companies (Borland, Microsoft, IBM, Kaspersky Laboratories). It should be also mentioned that Intel supported and provided the necessary funding for the development of three thousand school teachers of the Nizhni Novgorod region in the field of information technologies at UNN. This was held within the framework of the joint program “Teaching for the future” of the Russian Federation Education Ministry and Intel. All these activities were carried out on the basis of appropriate contracts between the parties involved.

To develop the integration function of the university that is involved in so many projects, not only a system for organizing project work should be set up, but also special units for informing about the opportunities to initiate such projects. A system for informing about R&D programs of Russian and foreign foundations (including the Framework R&D program of the European Union) has already been

set up at UNN. A special unit at the International Relations Department of the university performs the search for project funding on the basis of international grants. UNN is currently performing an international project aimed at developing cooperation in the field of information and communication technologies between EU and the Volga Federal District. Fig.3 shows the network of contact points in the Volga Federal District that help Russian scientists to form international consortia for making applications to get funding under Framework Programs of the European Union. This network of 100 contact points covers various organizations in the Volga Federal District. Currently, work is underway to set up a structure intended to initiate joint projects with local industries.

Certainly, integration processes are not confined to the sphere of natural sciences. They also involve industrial and socio-economic spheres and the humanities. Fig.4 shows a generalised diagram of interaction between the university acting as an integrator and research institutions, public and local authorities industrial enterprises, HEIs, schools, cultural and other institutions, as exemplified by UNN.

The university has concluded a contract with the regional prosecutor's office providing for the training of personnel. According to the contract, the prosecutor's office takes part in the development of respective specialization at the Faculty of Law (beginning from the 3rd year of studies), in selecting students for the studies in this specialization, in providing practical placements for these students at city and district prosecutor's offices. Besides, approximately 40 workers of the regional prosecutor's office are enrolled in an extramural Ph.D. program of the UNN or are candidates for Ph.D. degree.

A very important form of interaction contributing to high-class training includes the approach whereby well-known leaders in key institutions of financial, tax and other sectors are at the same time heads of respective departments at the university. Thus, for example, the Director of the Central Bank's Main Directorate in the Nizhni Novgorod region is at the same time head of department "Banks and banking". This person holds a Ph.D. in Economics and has the rank of Associate Professor. The department "Taxation Systems" is headed by Director of the Directorate of Federal Tax Service who holds the degree of Doctor of Sciences. A similar situation is at the department "Customs".

Of exceptional significance is the University's role in introducing new technologies in various types of activity, including, for example, electronic document circulation and electronic signature system. UNN in cooperation with respective agencies, has organised and equipped a training centre in this field, the only one such centre in the Volga Federal District. Participation of students and university staff in organisational and information support of the general census of population, jointly with state statistics agencies, is yet another example. Also worth a mention is the work performed by students and staff of the university in preparing the plans for social and economic development of the territory. Many more examples of such activities may be given.

The integration nature of the educational process organisation draws it closer to the tasks in new fields of activity, permits students to get familiarized with such activity in a practical manner, to provide respective services and employers with more staffing opportunities.

UNN is the centre of interaction networks in various areas of activity in the region. For instance, such a traditional type of activity as interaction with schools practiced by many HEIs is organised in UNN in a systemic manner in the form of vertical integration. The system of integration includes dozens of schools in the city and region of Nizhni Novgorod. The University provides the basis for school laboratories, circles and Sunday schools for gifted children, and for conducting over two dozens of Olympiads in different subjects for secondary school students. Many of such events are held in various locations in the region of Nizhni Novgorod jointly with the regional Ministry of Education.

Organisational Strategy of Integration

The implementation of the integration function which is largely new for universities needs new organisational and managerial approaches to be applied. As mentioned earlier, the university's integration function is understood as the one that ensures information interaction with external organisations. This interaction is a dynamic process accompanied by the emergence of new integration tasks requiring certain organisational changes. The management of organisational changes is known to be in the sphere of university strategic management. The application of strategic management methodology ensures that organisations can develop in a dynamic environment, when earlier approaches that were used successfully in the past become less efficient due to the changing external factors. To implement such organisational changes, modern managerial solutions are required, which are based on dynamic organisational structures. The organisation's mission and its strategic plan are the most important elements contributing to the implementation of the organisation's development goals.

The role of the university as a knowledge integrator obviously requires the application of strategic management methods, since external scientific, industrial, cultural, government and other structures are involved. The development of new dynamic methods of university organisation is a scientific challenge per se. We should note that any university, to be capable of organizing the interaction between external partners, should first learn to solve the problems of interaction between its own units and to acquire some management skills adopted in distributed "network" organisations.

In order to solve this problem, a unique managerial approach referred to as «project-oriented university» [5, 6] has been developed and refined at the State University of Nizhni Novgorod. This new method for organizing university operation provides the ways for implementing horizontal links [4, 6] between university units in the form of project-orientated organisational structures. Without destroying the “vertical” organisational basis for the development of scientific and pedagogical schools, this additional organisational technique permits to build a dynamic organisational subsystem that reacts adequately to changes in the external social and economic environment. In the university, the application of this approach may be exemplified by the Faculty of Management and Business that has approximately 3000 students and fully relies on the teaching staff of other faculties of the university. The ideas of

project-oriented management are also used extensively by the State University of Nizhni Novgorod in its interaction with external organisations. The university has adopted its mission that includes the provisions about the university's integrating role and the methods for its implementation on the basis of the project-oriented approach [8].

Conclusion

A large multiple-discipline classical university has a very special role to play in a Russian region. It integrates not only the sphere of science and education, but also the socio-cultural sphere. It is a large-scale integrator, an alma mater for many participants of social, economic and political life. The university's role in the past was also significant, but never before this sort of functions had such a large scale. This is due to the fact that it is natural for a university to be universal, to represent all branches of knowledge, to be able to play a constructive role in all spheres of activity.

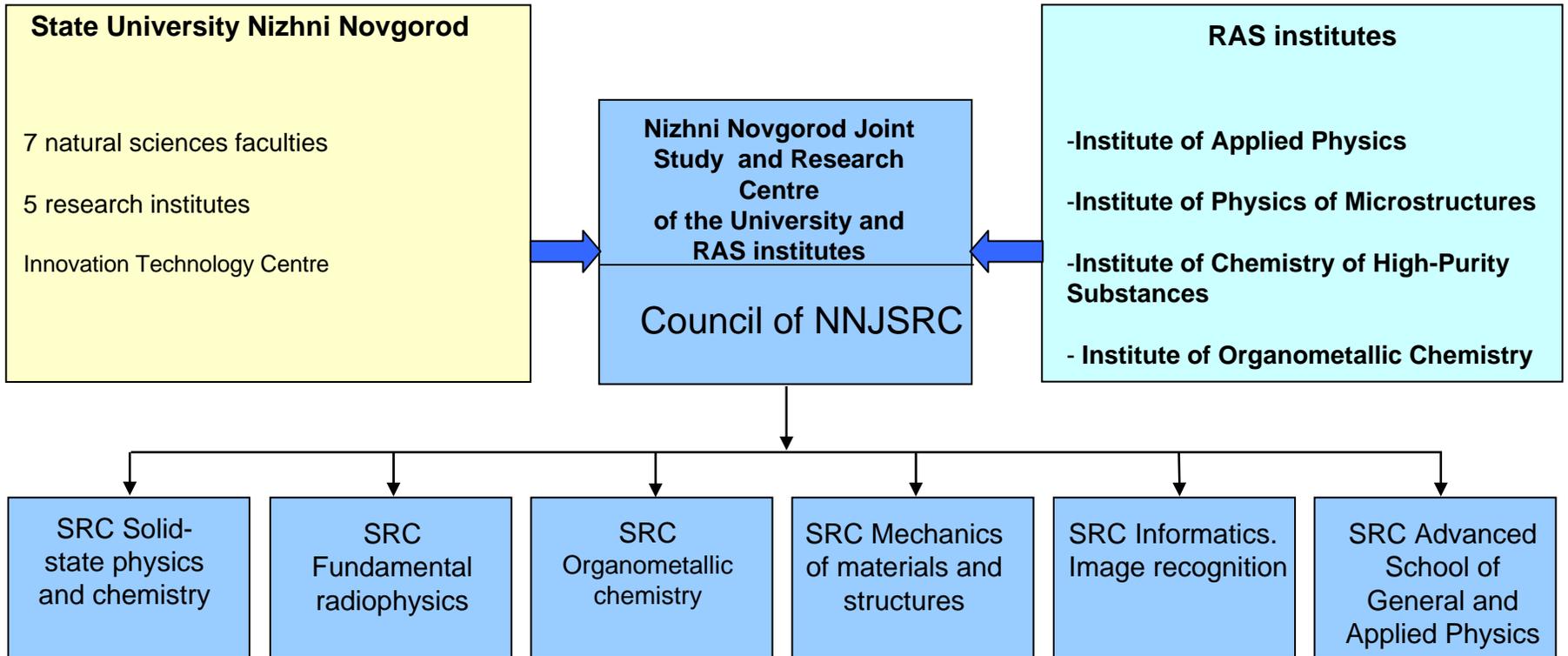
The emergence of the phenomenon of knowledge integrator is a logical stage in building the information society. Leading universities assume this function while solving the tasks of self-development, of the development of their region and of Russian society as a whole. Modern international and Russian experience shows that integration strategy is the main way to enhance the university's competitiveness in the global society.

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**Fig 2. Nizhni Novgorod Joint Study and Research Centre
of the University and RAS institutes**



Base faculty of UNN in the RAS Institute of Applied Physics; 4 base departments and 12 department branches in RAS institutes
 Base laboratories of RAS institutes in the University
 Shared use centers for unique equipment
 Training of top-qualification personnel, joint work in 10 Doctoral dissertation councils

Fig.3. The network for developing cooperation between EU and the Volga Federal District in the field of information and communication technologies

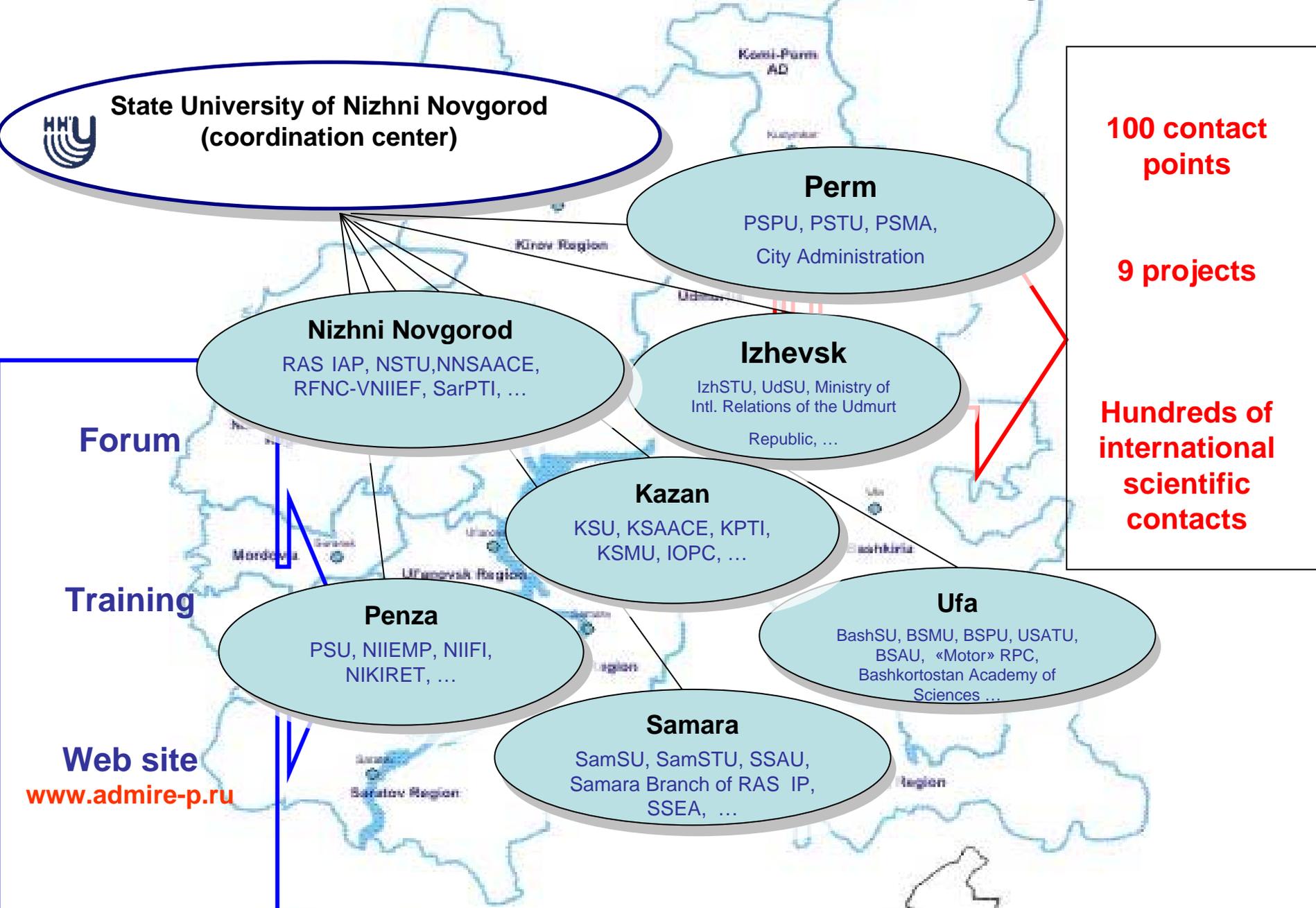


Fig.4. The university as a centre of integration. Interaction networks of the University

